

ISP203A – Global Change  
Feedback Loops

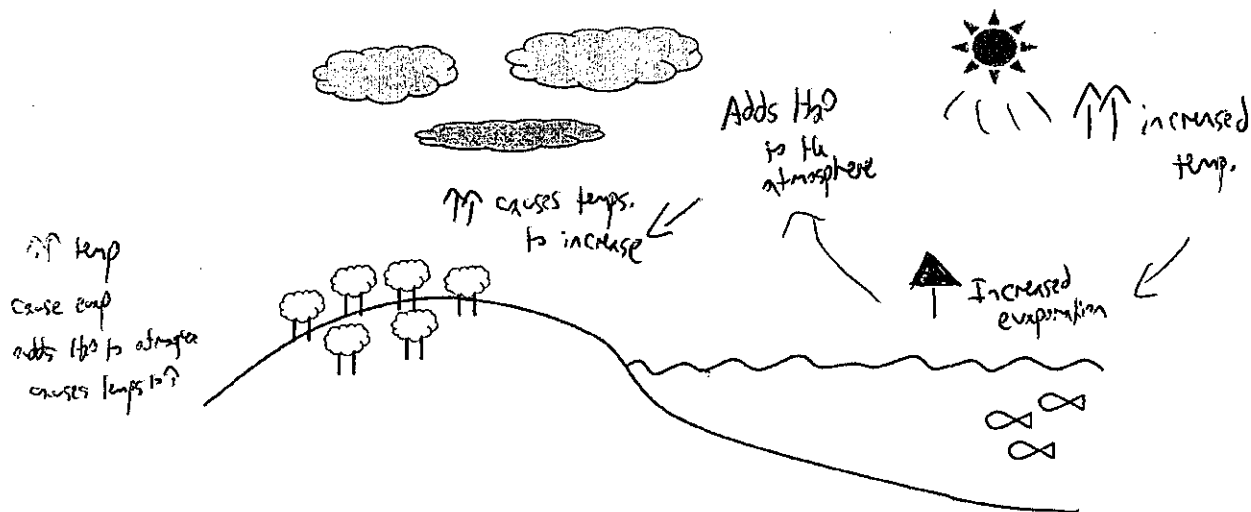
GROUP #: A  
Student IDs of Members Present:  
A40246306 A40706302  
A41604022 A43573450  
A41749376

**Part 2: Group Work**

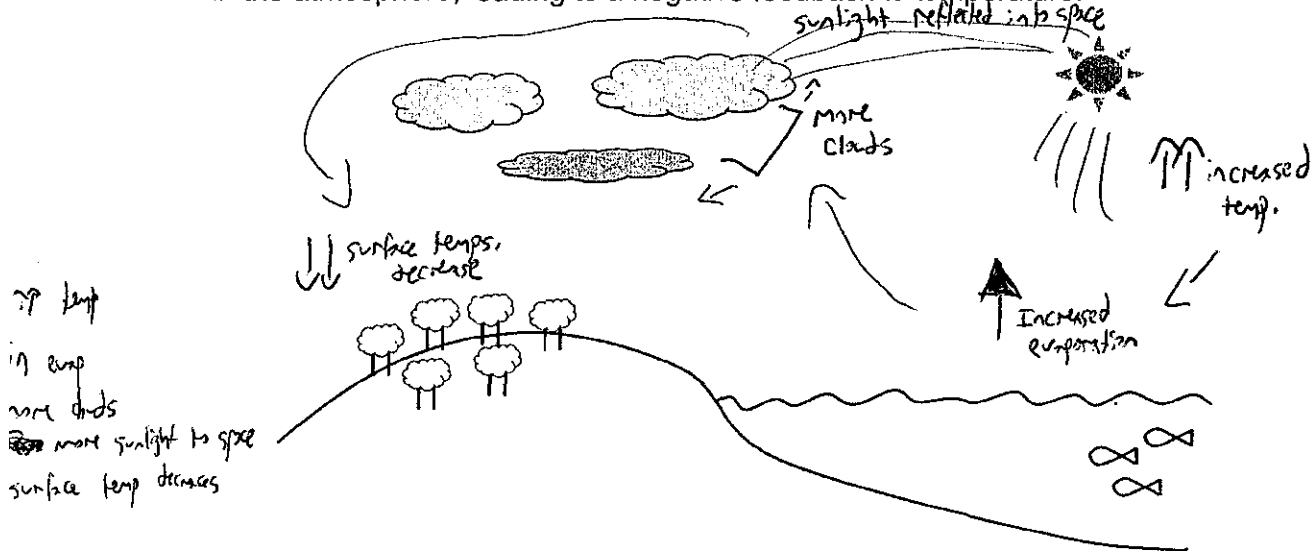
Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: A change in the system causes further changes in the system such that some component in the system increases overall.
2. Negative feedback: A change in a system causes an opposite response in the system such that the system is closer to equilibrium.

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

An event (temp. increases) causes events that causes less of the same (temp. increases less).

B. Which specific step makes this a negative feedback loop?

The step of the clouds blocking and reflecting the sunlight back to space because if that sunlight went to the surface it would be positive.

C. How might cloud cover produce a positive feedback?

When you create clouds the bands being formed create heat which could become a positive feedback if temperatures are increased which would increase evaporation.

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

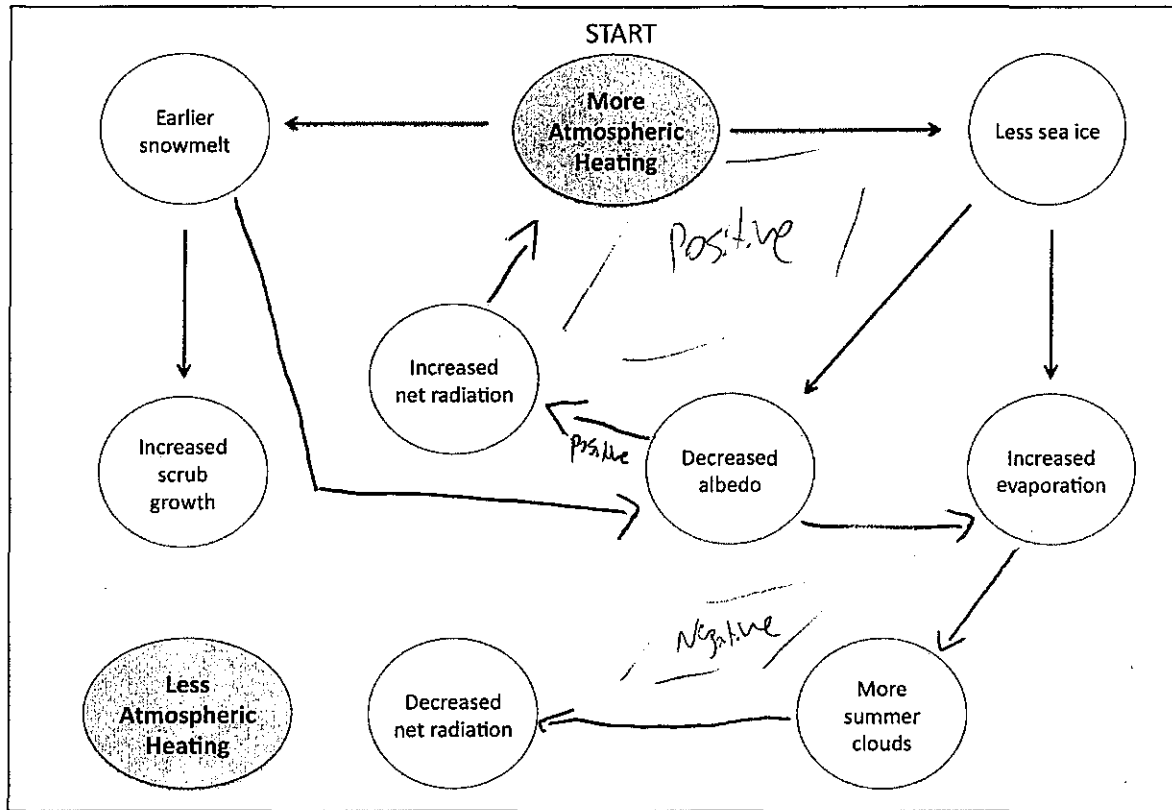
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

If global warming causes the loss of glaciers it would be a positive feedback loop because the melting of the glaciers would create more water to get ~~out~~ evaporated into the atmosphere leading to create clouds which creates heat, continually increasing the earth's temperature.

## ISP203A – Global Change Feedback Loops

AA

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

The decreasing of albedo increases evaporation which created more summer clouds which ultimately decreased net radiation which was a negative feedback loop which brings the system closer to equilibrium.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

The presence of more atmospheric heating causes less sea ice which causes decreased albedo which increases net radiation. That positive feedback loop explains how it's moving away from equilibrium because it is a constant increased temp. which is positive.

ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

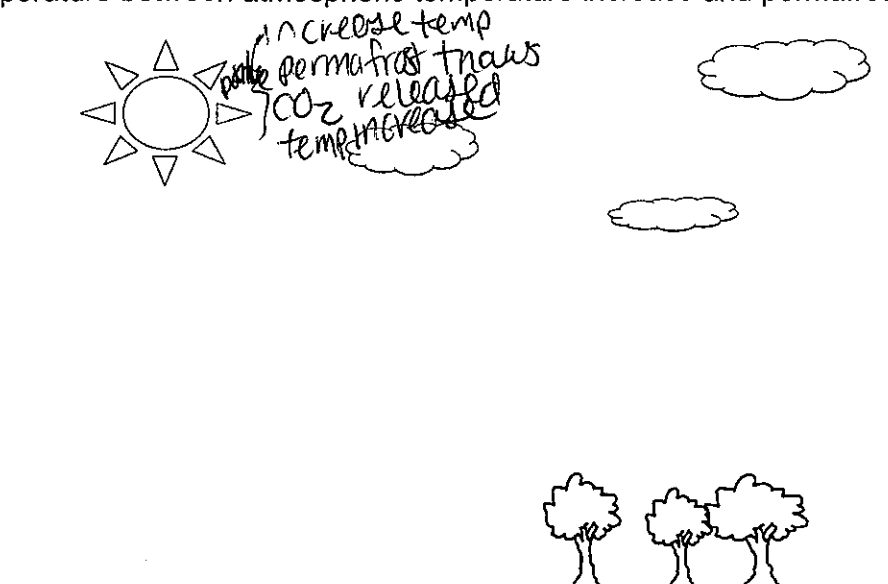
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.  
*The state of balance of energy*
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



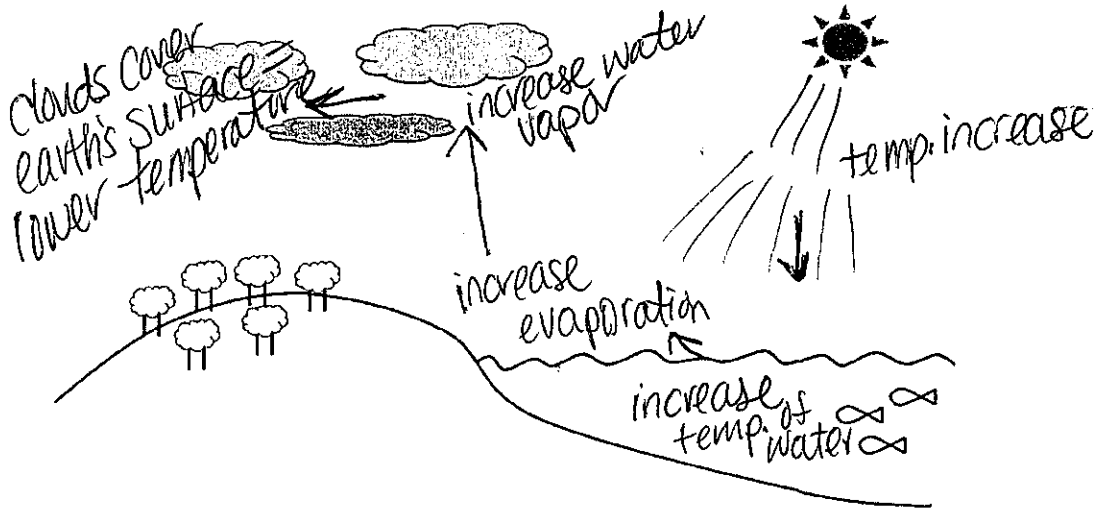
GROUP #: B  
Student IDs of Members Present:  
[REDACTED] A40290629  
[REDACTED] A43979700  
[REDACTED] A3963430

### Part 2: Group Work

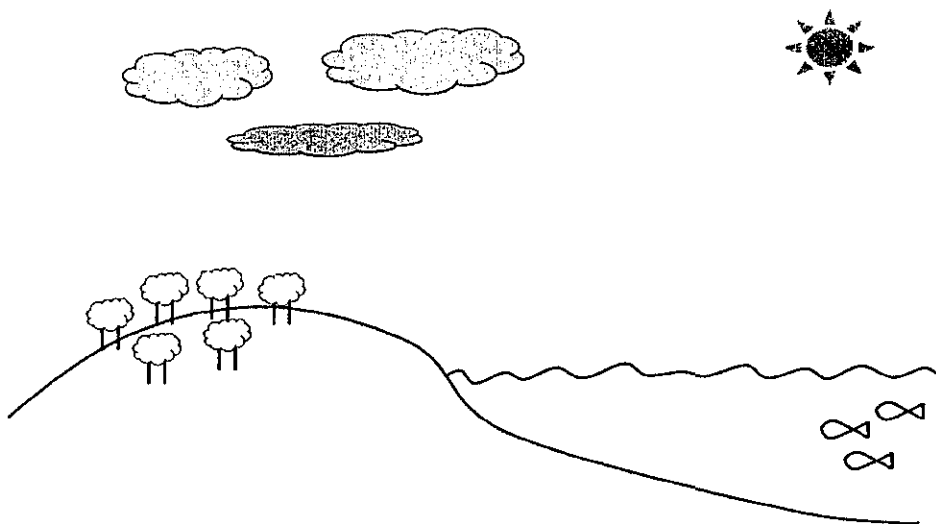
Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: Change causes reaction to further the original change
2. Negative feedback: When change occurs, system reacts & moves back toward equilibrium

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



B

### Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?  
*When the temperature increases, this causes more evaporation. This means more water vapor in the atmosphere = more clouds covering Earth. This results in a decrease in temperature.*
- B. Which specific step makes this a negative feedback loop?  
*1) increase temp  
2) more evaporation  
3) more water vapor in atmosphere = more clouds  
4) cooler temp.*
- C. How might cloud cover produce a positive feedback?  
*When clouds are made, energy is released into the atmosphere, which releases heat.*

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

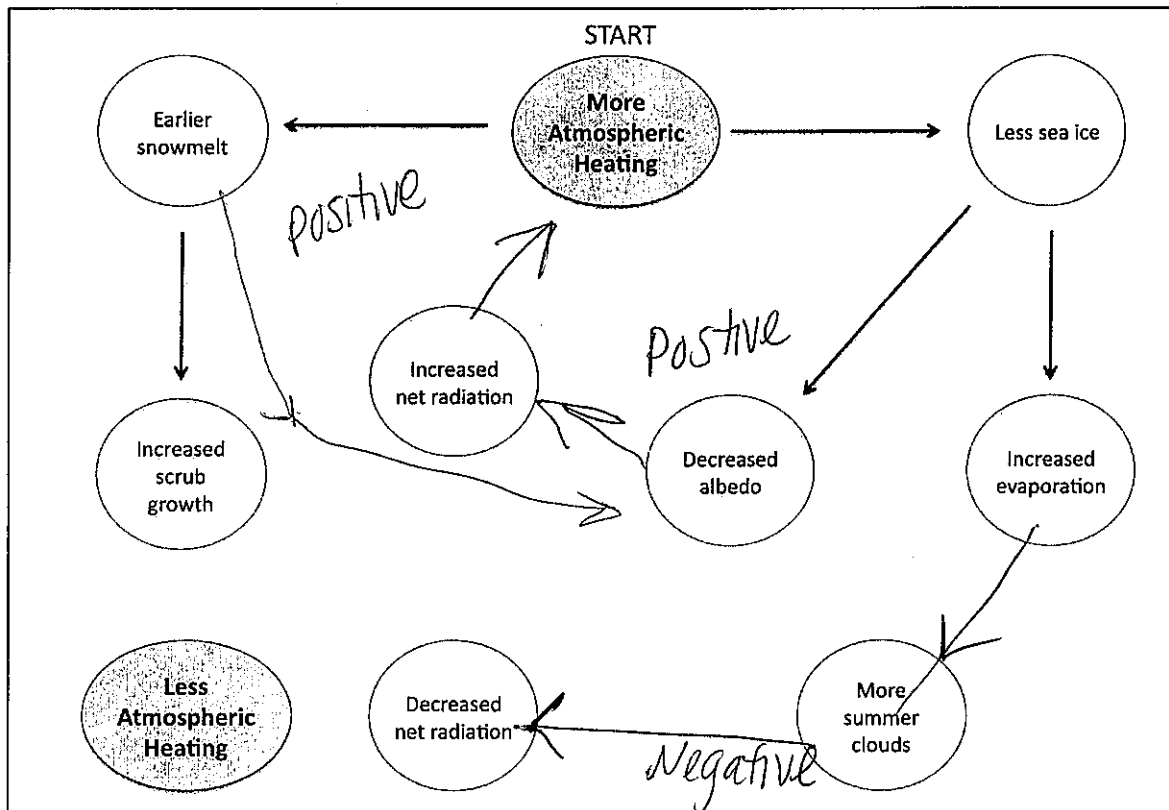
- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

*Positive feedback - Sun's radiation isn't being reflected. Instead it's being absorbed & increasing temp. in the same direction*

ISP203A – Global Change  
Feedback Loops

B

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More atmospheric heating cause less sea ice which decreases albedo because heat is absorbed & increase temp.  
More atmospheric heating → less sea ice → increased evaporation  
this means more clouds & temp.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

ISP203A – Global Change  
Feedback Loops

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

**Aerosols**

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

*Cooling*

**Rainforest**

Cutting down large portions of the forests on Earth kills living plants that remove CO<sub>2</sub> from the atmosphere through respiration.

*global warming*

**Permafrost**

Melting of permafrost will release methane gas, a greenhouse gas.

*global warming*



ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

pos - more of change  
neg - causes opp.

**Part 1: Class Work**

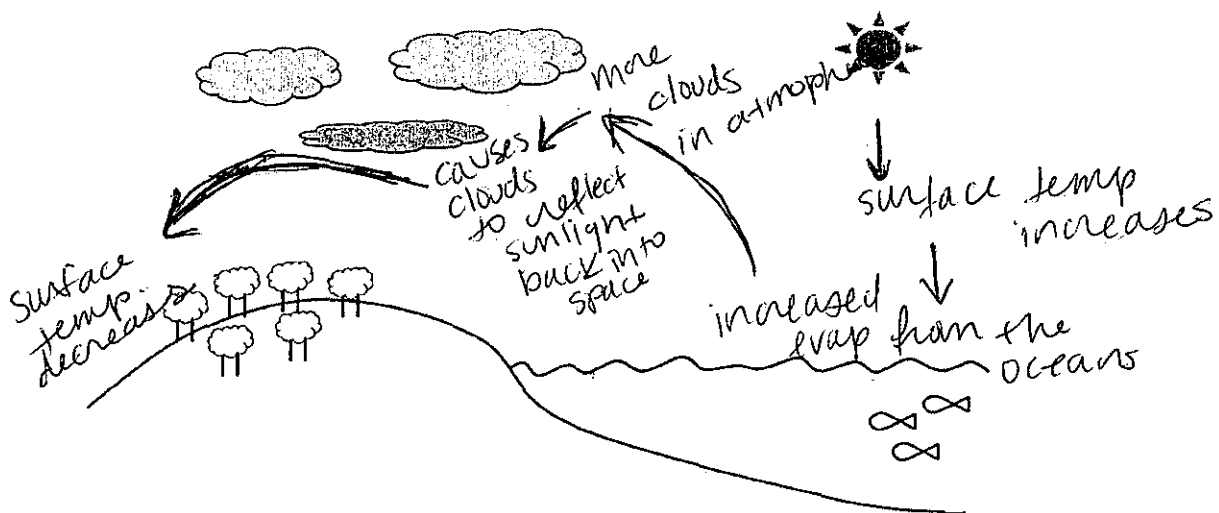
A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



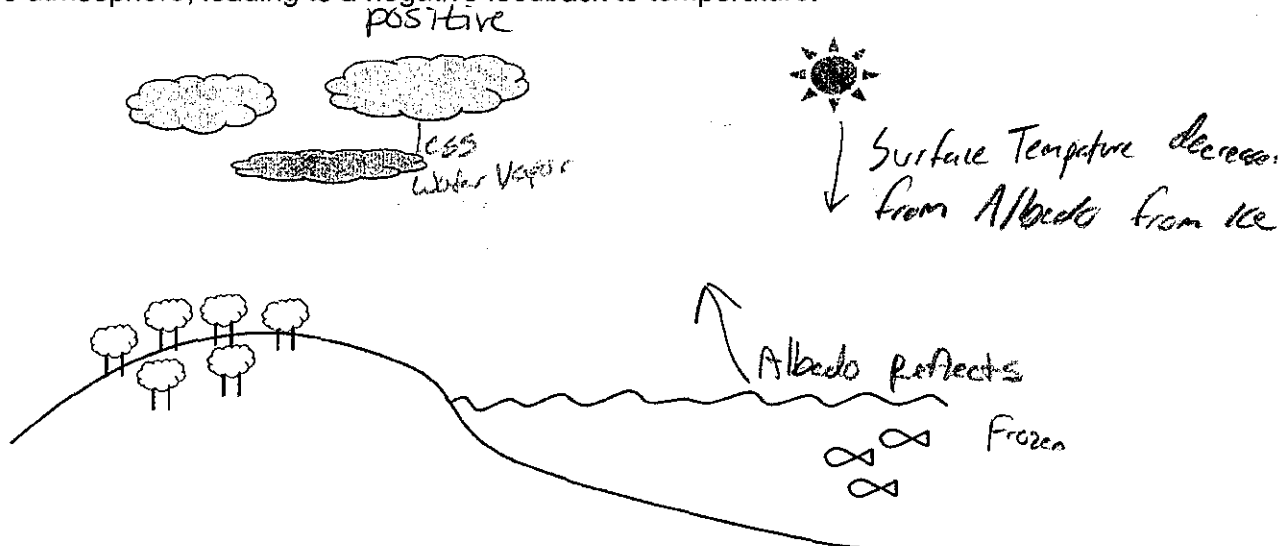
### Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: A change that causes more of the same change.
2. Negative feedback: A change that causes the opposite reaction.
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ feedback to temperature.



### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Clouds reflect sunlight back into space causing a cooler temperature.

B. Which specific step makes this a negative feedback loop?

The increase in temperature could cause so much evaporation that more and more clouds are formed blocking sunlight.

C. How might cloud cover produce a positive feedback? from entering the atmosphere

The temperature could already be at a cold state so the increase in cloud cover would only ensure the coldness of the temp.

### Albedo:

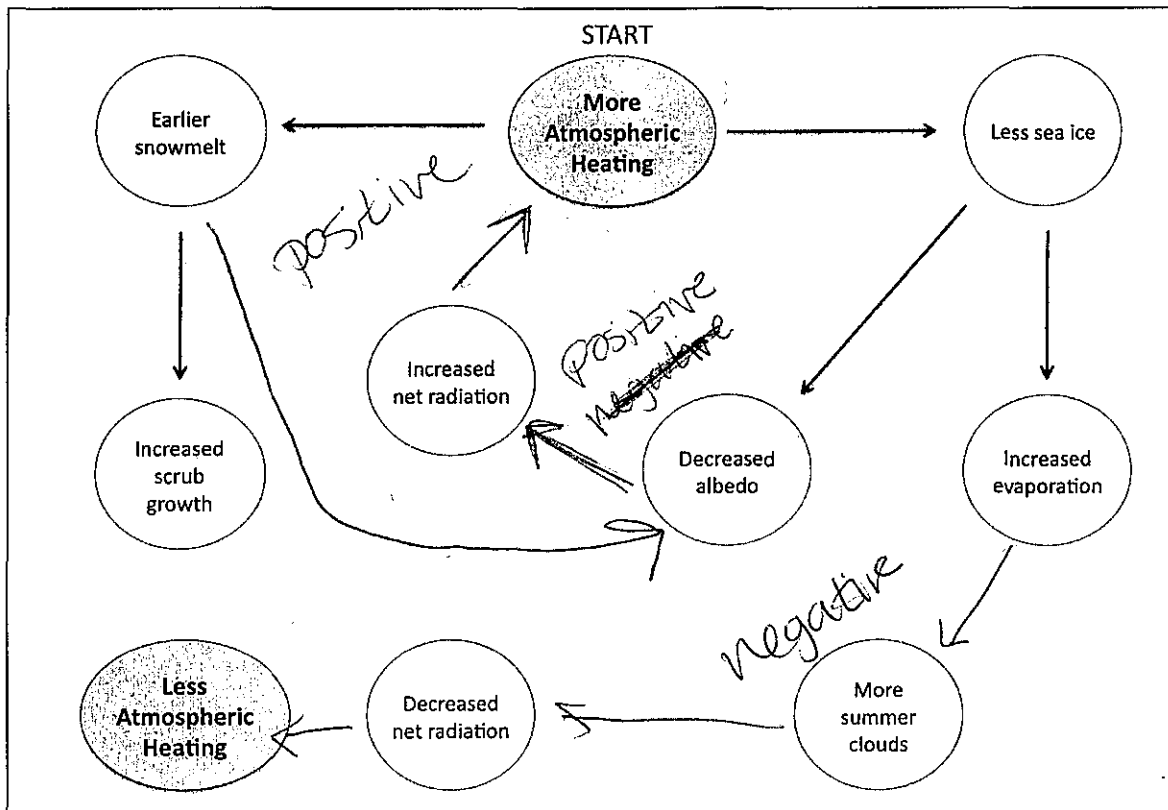
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Negative because the heating of earth's surfaces causes an opposite reaction (instead of getting warmer, the ice sheets retreat and the glaciers melt, which is a negative feedback).

ISP203A – Global Change  
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

The system starts off at w/ more atmospheric heating and ends w/ less atmospheric heating.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Positive feedback keeps the cycle going w/ the same changes essentially making no change and not moving away from equilibrium.

ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

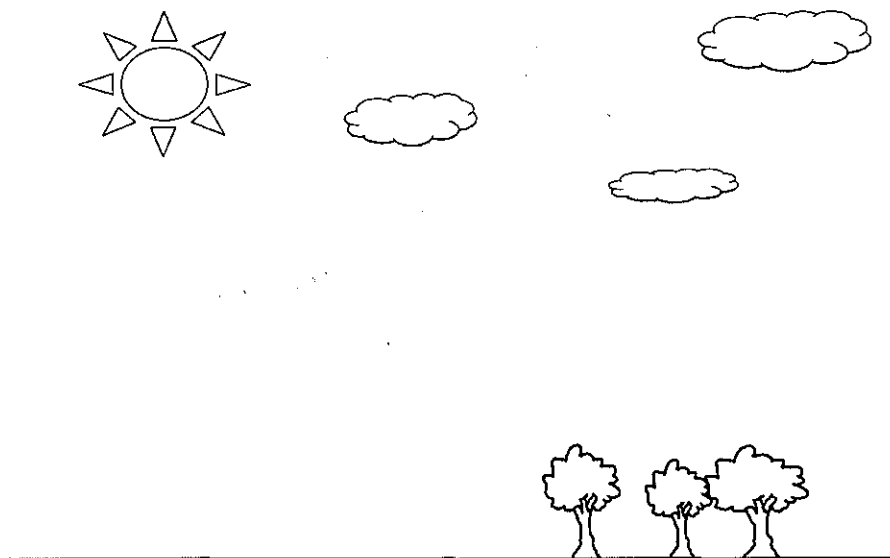
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

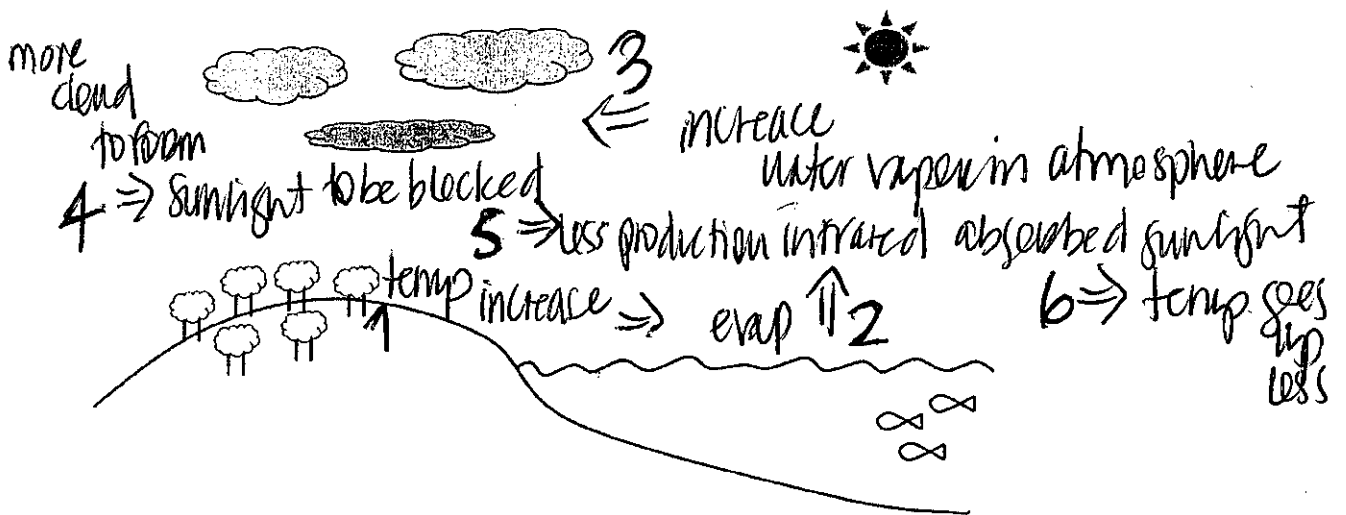
A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



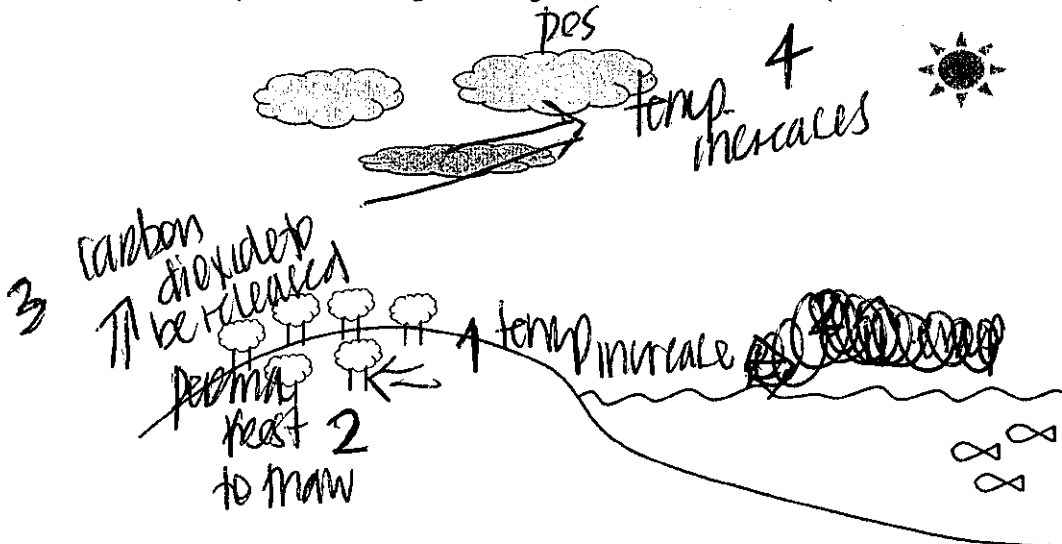
### Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: *event which causes an event which causes more of the same initial event*
2. Negative feedback: *event that causes event that causes less of initial*
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ feedback to temperature.



D

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Temp increase  $\Rightarrow$  more evap  $\Rightarrow$  more water vapor in atmosphere  $\Rightarrow$   
more clouds  $\Rightarrow$  more incoming sunlight to be blocked  $\Rightarrow$  less production

B. Which specific step makes this a negative feedback loop?

blocking sunlight

infrared rays  $\Rightarrow$   
less increase temp

C. How might cloud cover produce a positive feedback?

energy needed to form clouds  $\Rightarrow$   
creating heat  $\Rightarrow$  ~~regulating temp from~~  
~~continually increasing~~ increases temp

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

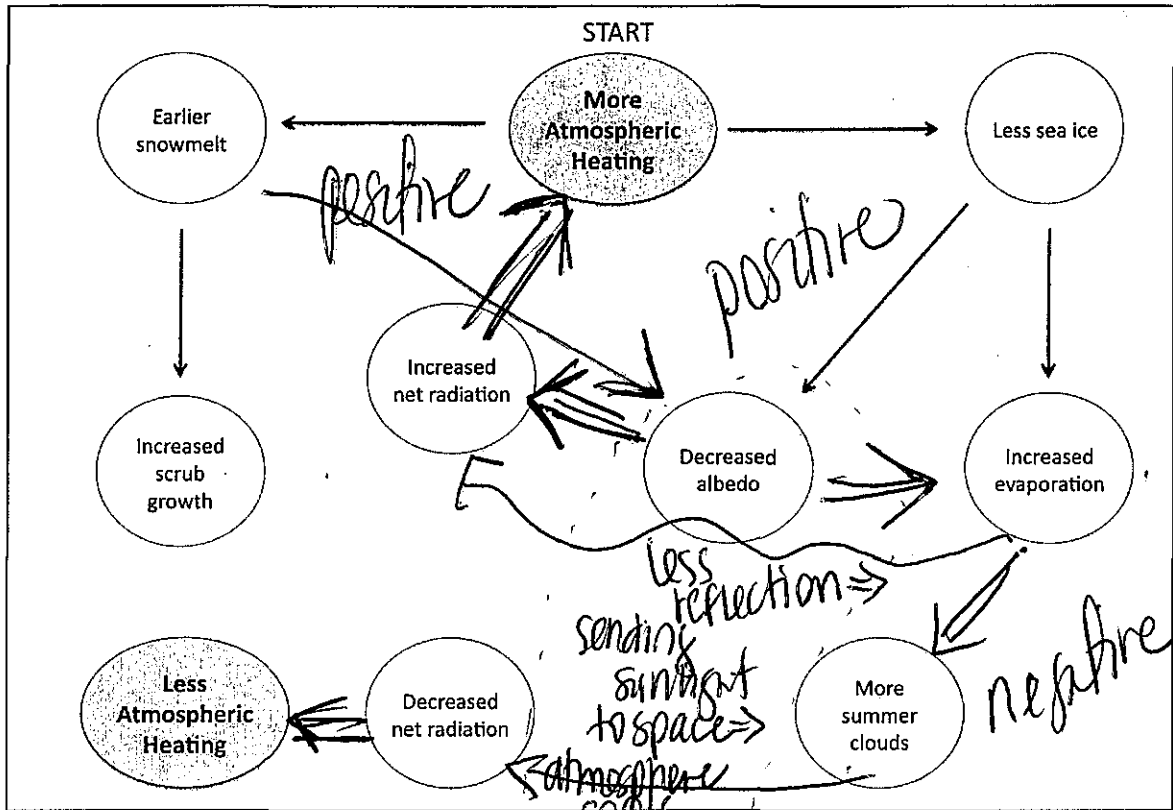
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

~~positive feedback, similar to permafrost~~  
~~melting,~~  
neg feedback; releases more water vapor  
into atmosphere  $\Rightarrow$  more evap  $\Rightarrow$  more  
clouds  $\Rightarrow$  more blocked sunlight  $\Rightarrow$   
less production infrared rays  $\Rightarrow$   
less increased temp

ISP203A – Global Change  
Feedback Loops

D

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

more heating  $\Rightarrow$  less sea ice  $\Rightarrow$  increased evap  $\Rightarrow$  more summer clouds  $\Rightarrow$  decreased net radiation  $\Rightarrow$  less atmospheric heating

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

more atmospheric heating  $\Rightarrow$  less sea ice  $\Rightarrow$  decreased albedo  $\Rightarrow$  increased net radiation  $\Rightarrow$  more atmospheric heating



## ISP203A – Global Change Feedback Loops

### Objectives

Upon completion of this activity, you will be able to:

• Identify positive and negative feedback systems

- Describe how feedback systems impact global climate change

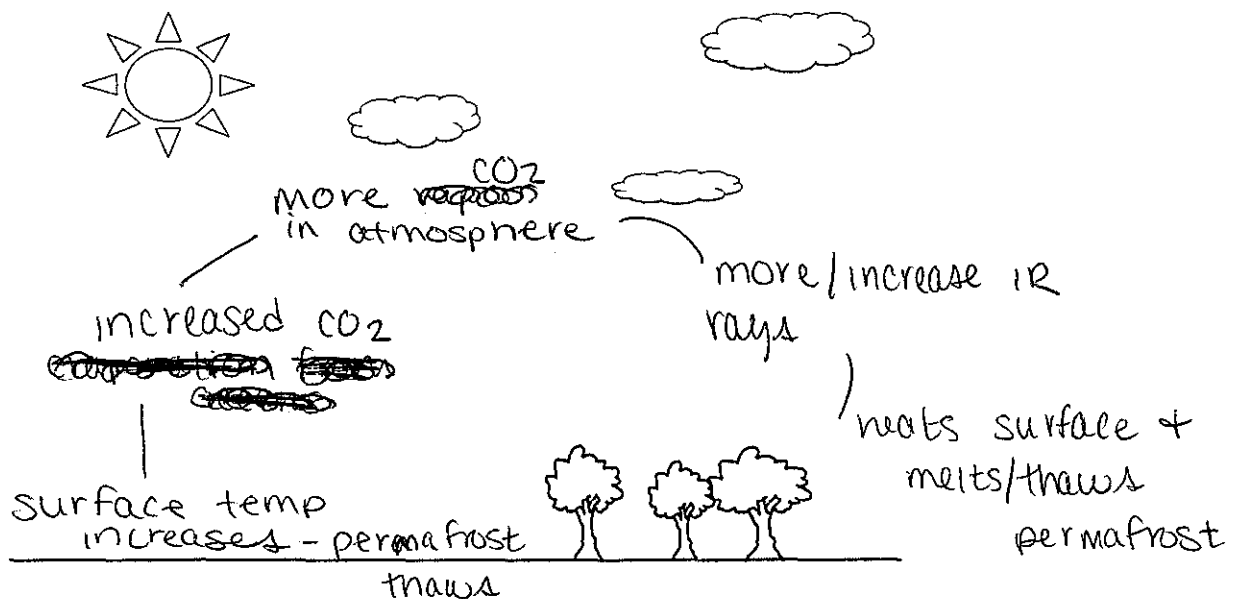
### Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

### PART 1: Background Notes

#### Part 1: Class Work

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



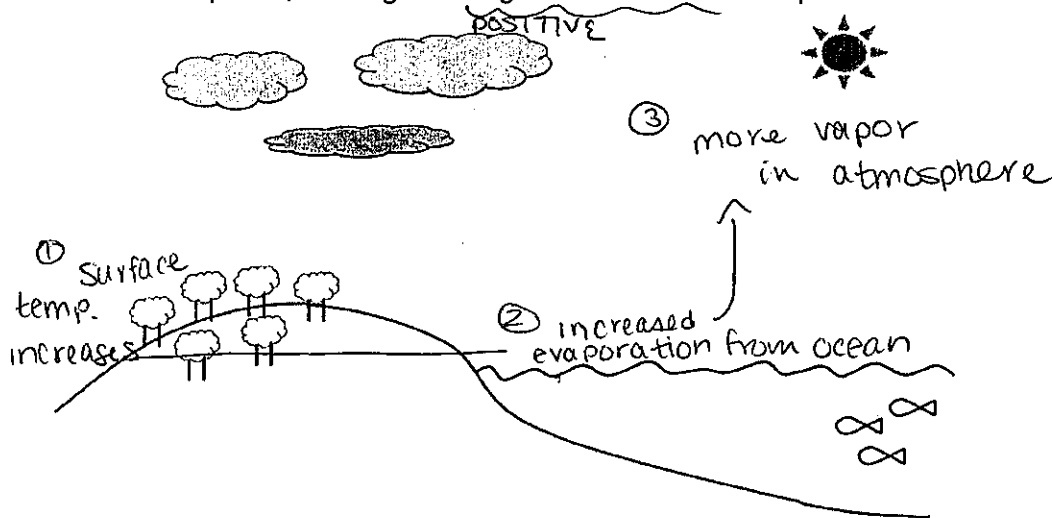
GROUP #: **E**  
Student IDs of Members Present:

~~XXXXXXXXXX~~ A40518681  
~~XXXXXXXXXX~~ A2922816  
~~XXXXXXXXXX~~ A42190700  
~~XXXXXXXXXX~~ A41503028

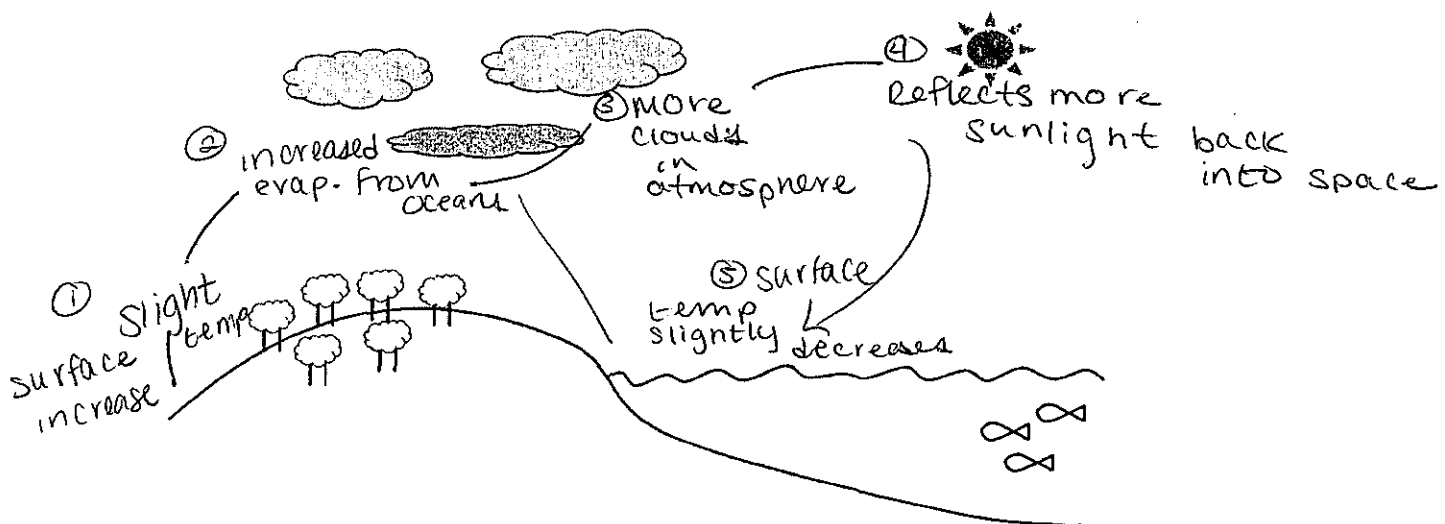
### Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: change causes enhanced reaction of another system so component in system increases
2. Negative feedback: @ equilibrium a change in system overall an opposite effect such that it (system) moves against origin
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



41  
E

### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

b/c negative feedback results in an opposite change in system & cloud cover blocks sunlight; less IR; less warm climate.

B. Which specific step makes this a negative feedback loop?

Many: the cloud cover blocks sunlight which in turn causes less IR rays, which causes an ~~opposite~~ effect in the warming climate cycle.

C. How might cloud cover produce a positive feedback?

Cloud cover releases ~~more~~ water vapor & the bonds release energy which create heat & temp goes up more; enhancing effect - positive feedback.

### Albedo:

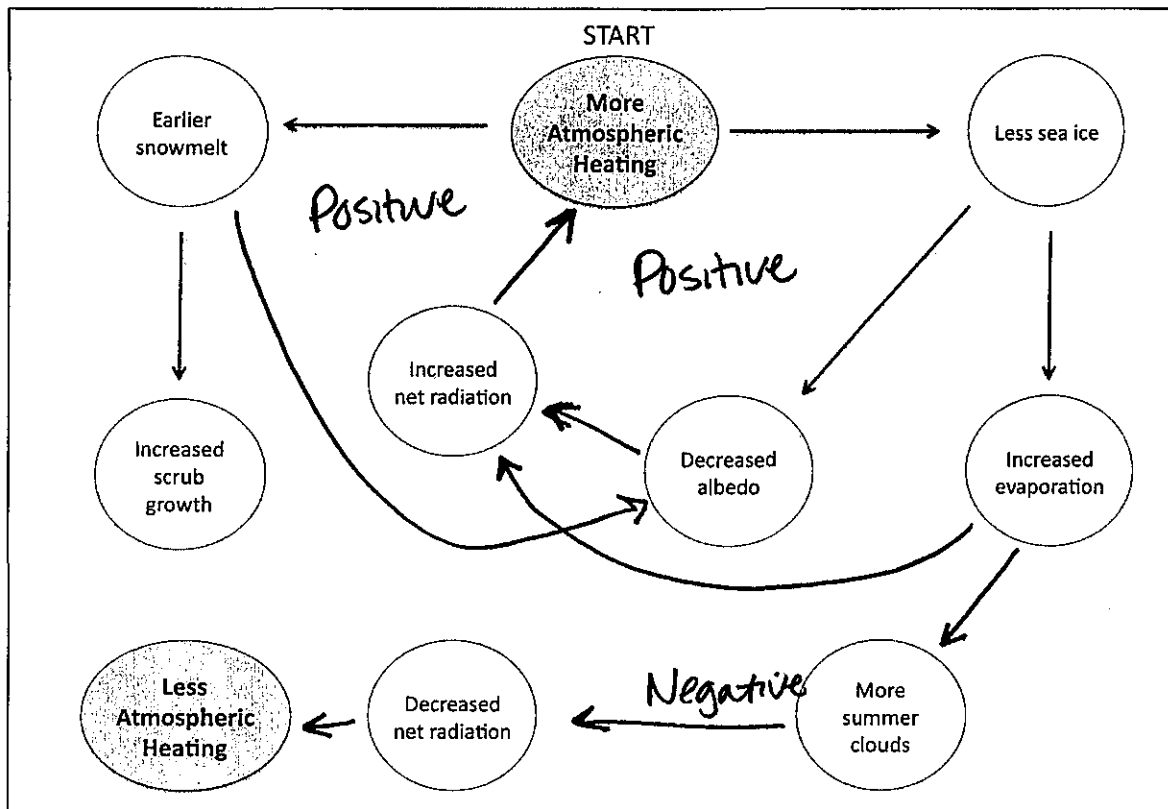
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive. Without glaciers, more rays/heat would be absorbed rather than reflecting it, increasing temperatures and melting more glaciers.

ISP203A – Global Change  
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium. *Heating atmosphere → Less sea ice → more water → more evaporation → more cloud cover → cools atmosphere*

*Starts off hot, returns to equilibrium by cooling.*

- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

*Melting sea ice makes less reflective surfaces, absorbing more heat, + making more atmospheric heating.*

## ISP203A – Global Change Feedback Loops

### Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

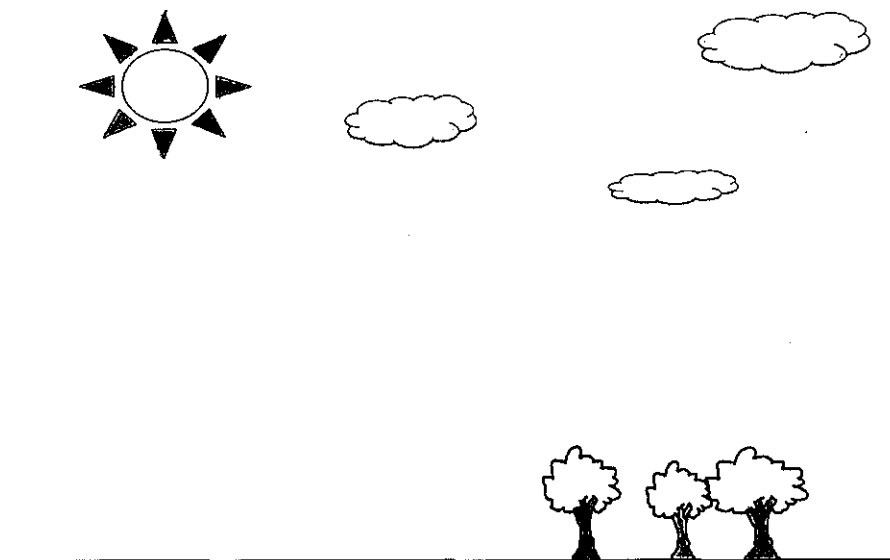
### Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

### PART 1: Background Notes

#### Part 1: Class Work

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



GROUP #: **F**

Student IDs of Members Present:

A42395484

A42766836

A41450320

A43864729

## Part 2: Group Work

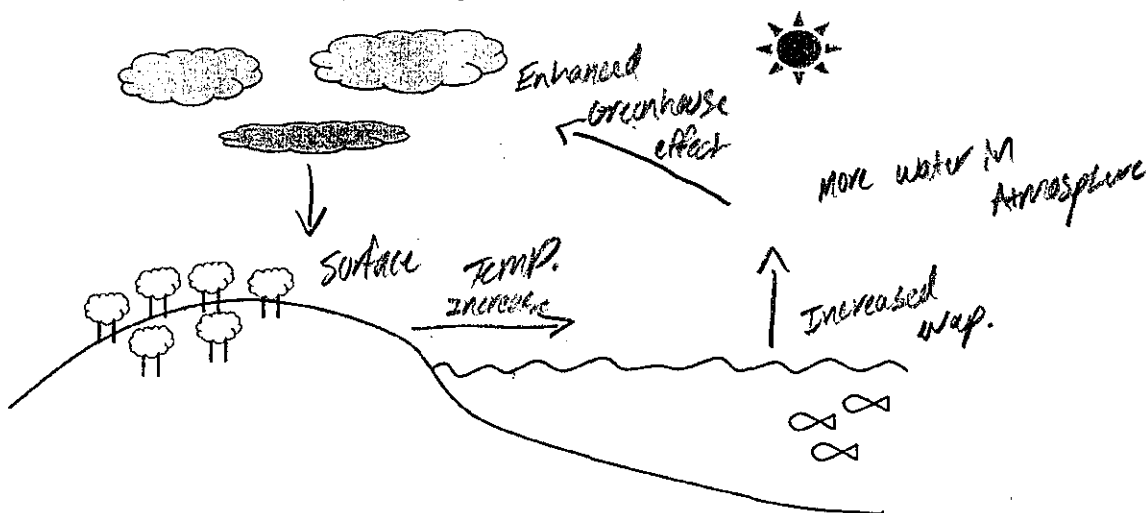
Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: *Increase in components in system due to cause*

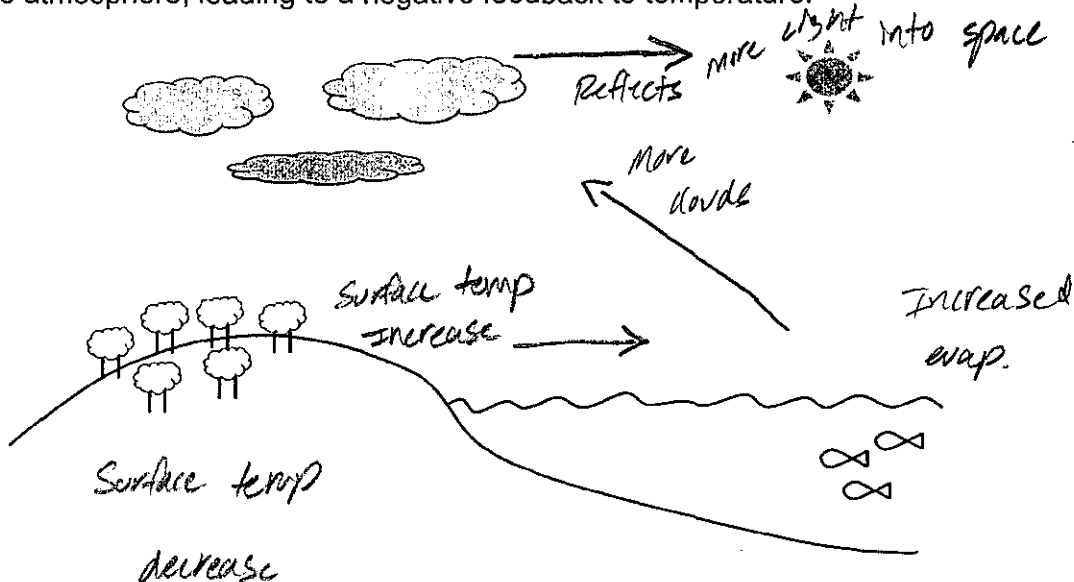
2. Negative feedback:

*decrease changes in system change causes pushback*

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because it blocks sun radiation

B. Which specific step makes this a negative feedback loop?

Blocking the radiation rays can't reach surface

C. How might cloud cover produce a positive feedback?

By bonding molecules energy is released:  
increasing atmospheric temperature

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

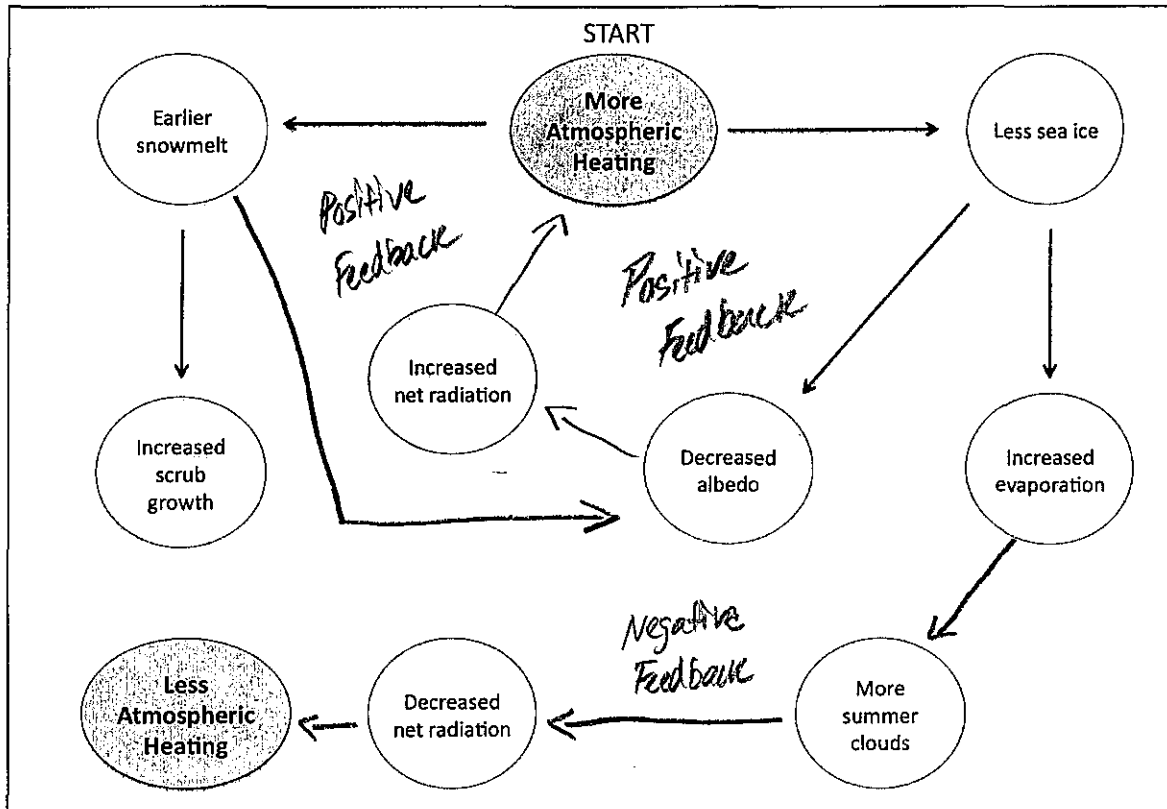
There is a positive & negative feedback

The positive is created by more heat being absorbed.

The negative is caused by increased evaporation leading to more greenhouse gases

# ISP203A – Global Change Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

*cloud cover*

*Temp ↑ → Evap ↑ → clouds ↑ → sunlight Blocked*

*which causes less heat absorption*

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

*Permafrost*

*x CO<sub>2</sub> → Temp ↑ → Permafrost Thaw → methane → + Temp ↑*

4

*= Temperature Increase*



ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

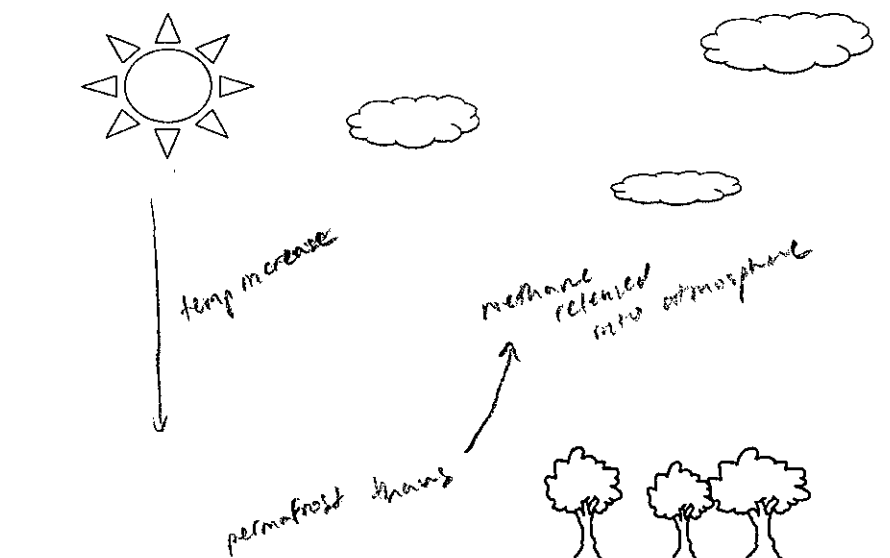
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



GROUP #: G  
Student IDs of Members Present:  
A40737921 A41398990  
A40659708  
A42235241

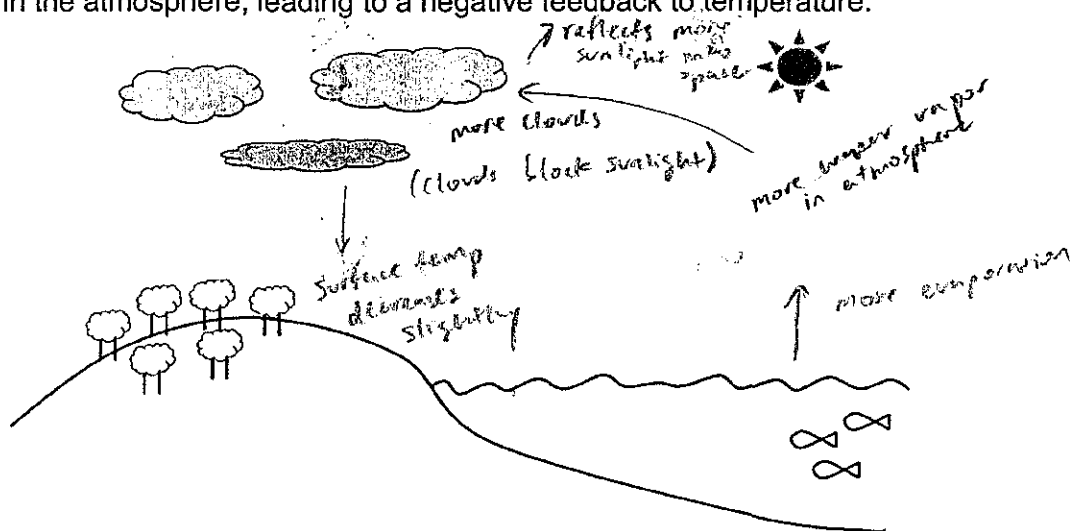
## Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

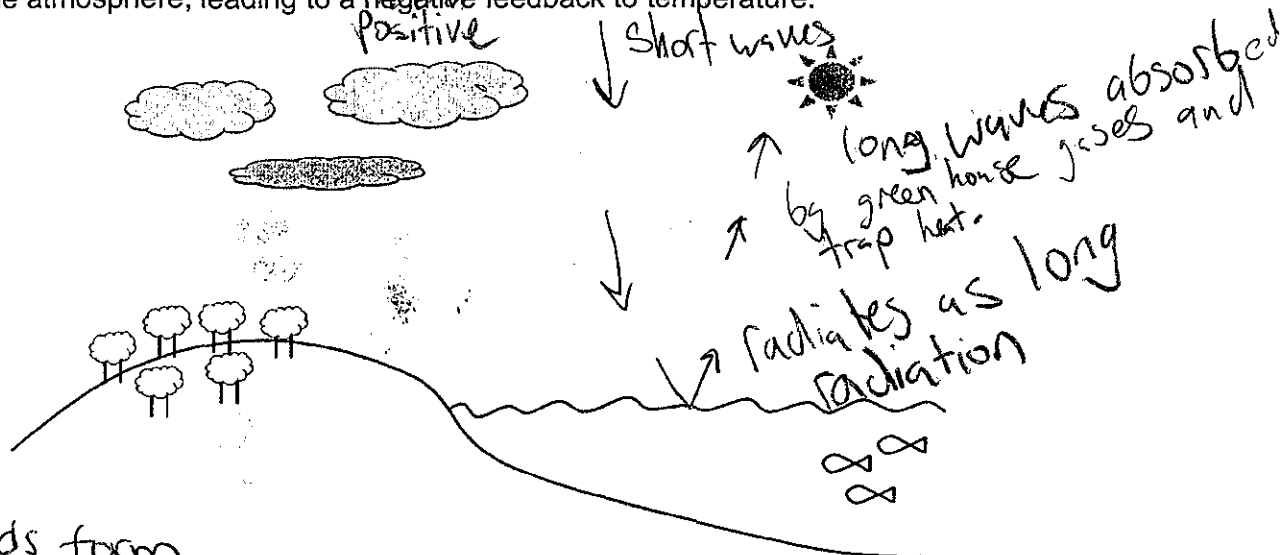
1. Positive feedback: change causes reaction to further the original change

2. Negative feedback: change occurs, system reacts and moves back towards equilibrium

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



as clouds form  
there is energy  
released into the  
atmosphere - warming it up.

G

**Questions**

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because it reflects some of the ~~sun's~~ sunlight from hitting earth, lowering the temperature.

B. Which specific step makes this a negative feedback loop?

less production of infrared from absorbed sunlight...

C. How might cloud cover produce a positive feedback?

when clouds form it releases energy into the atmosphere, warming the atmosphere...

**Albedo:**

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

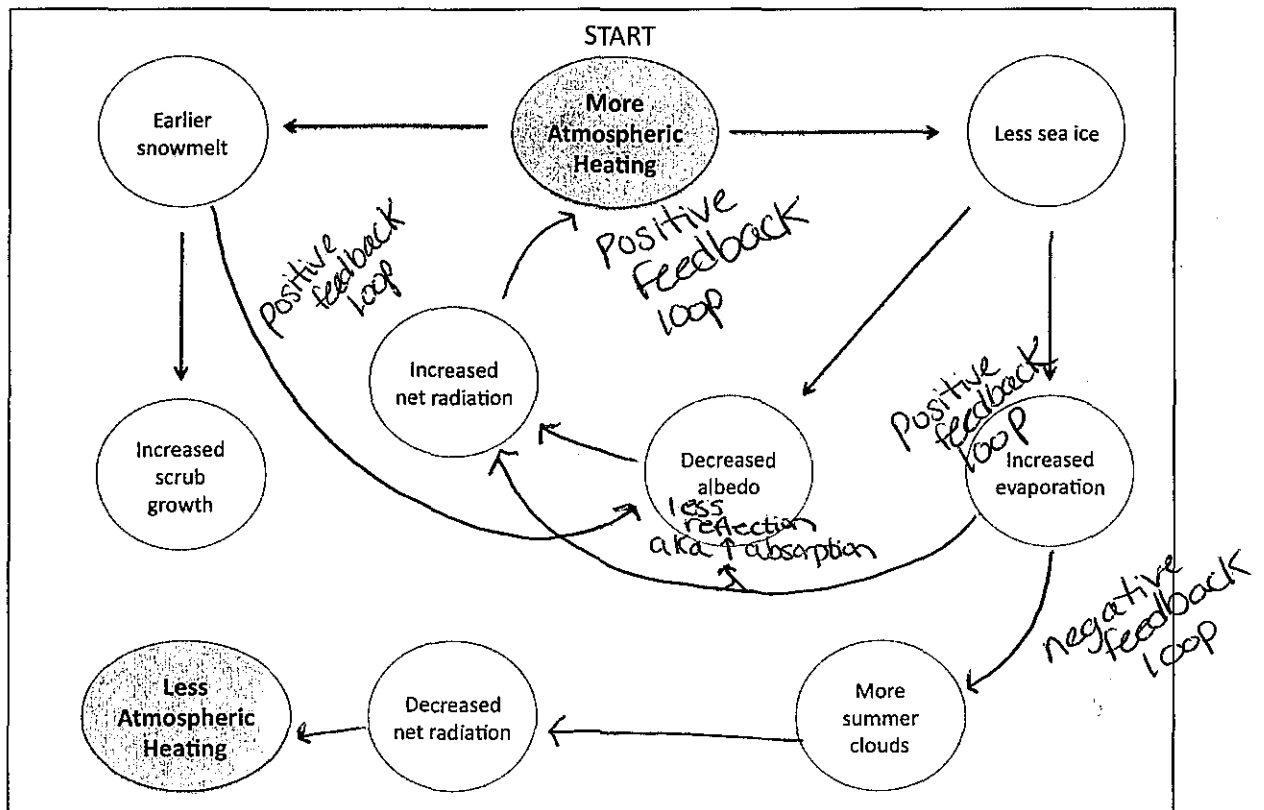
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive - more radiation from the sun is absorbed & thermal energy is radiated towards the atmosphere to be absorbed by greenhouse gases, warming the atmosphere and continuing to melt ice.

ISP203A – Global Change  
Feedback Loops

6

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

more atmospheric heating → less sea ice → inc. evaporation → more summer clouds → dec. net radiation → less atmospheric heating

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

more atmospheric heating → less sea ice → dec. albedo → increased radiation → more atmospheric heating

## ISP203A – Global Change Feedback Loops

### Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

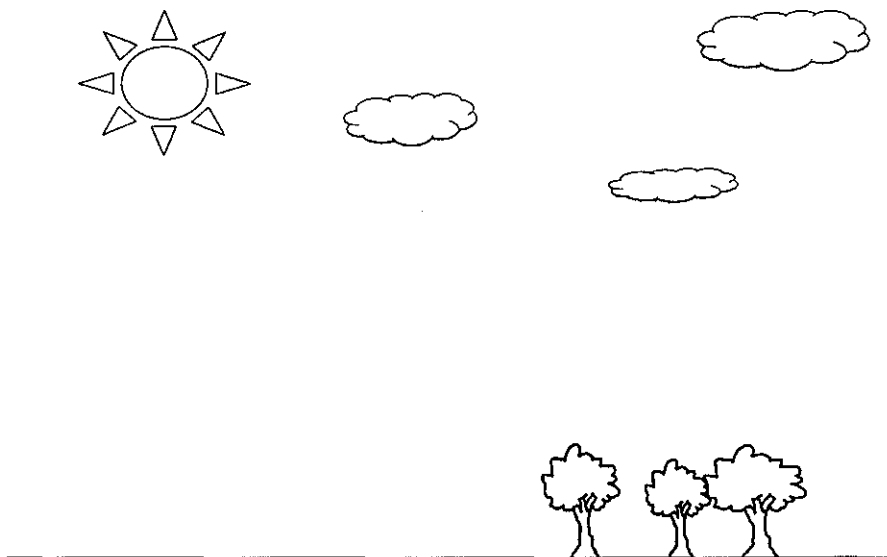
### Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

### PART 1: Background Notes

#### Part 1: Class Work

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



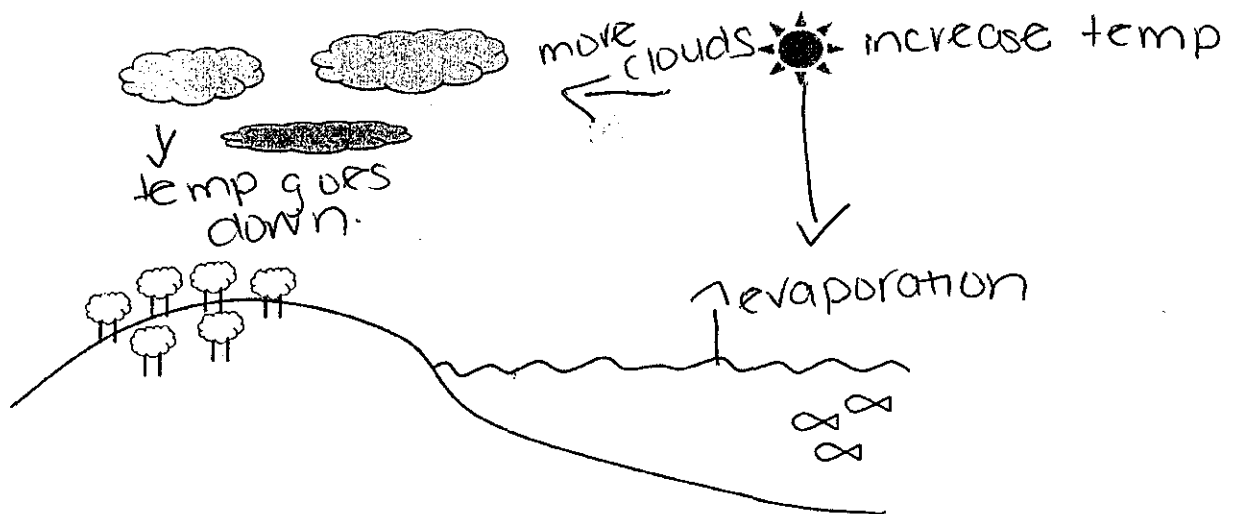
ISP203A – Global Change  
Feedback Loops

GROUP #: 4  
Student IDs of Members Present:  
A45139440  
A39995552  
A46250026

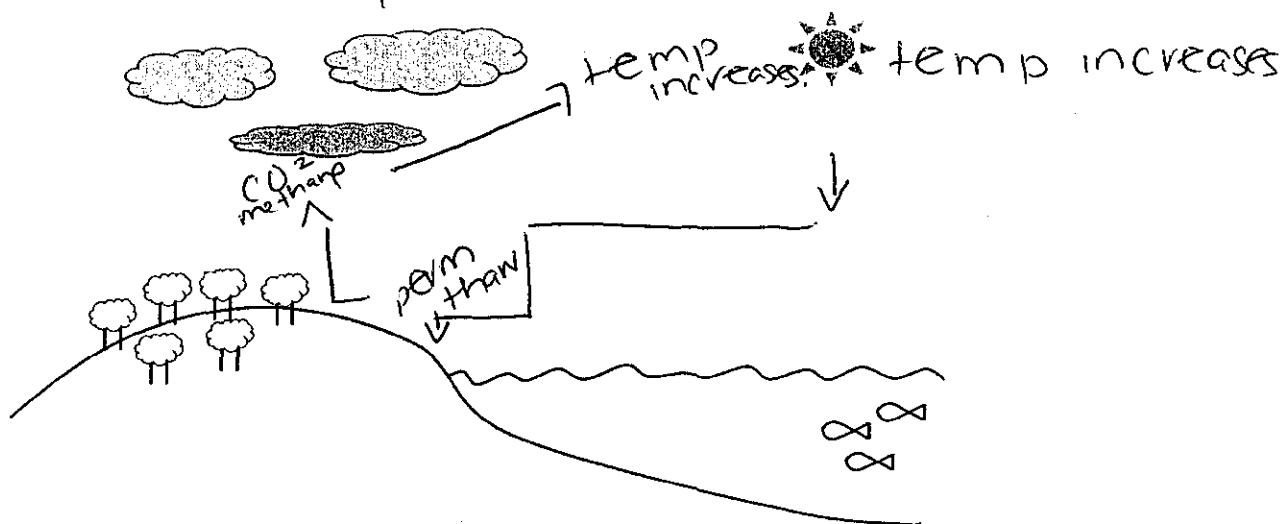
Part 2: Group Work

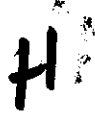
Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: Causes reaction to further the original change in system.
2. Negative feedback: Change that causes the opposite response in the system.
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because cloud cover blocks sunlight making ~~area~~ surface temp. drop.

B. Which specific step makes this a negative feedback loop?

~~the temp increasing in the beginning & it decreasing in the end.~~  
the temp increasing in the beginning & it decreasing in the end.

C. How might cloud cover produce a positive feedback?

When clouds are formed from water vapor, liquid water molecules are formed. When bonds are created, energy is released, which gives off heat = temp. increase.

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

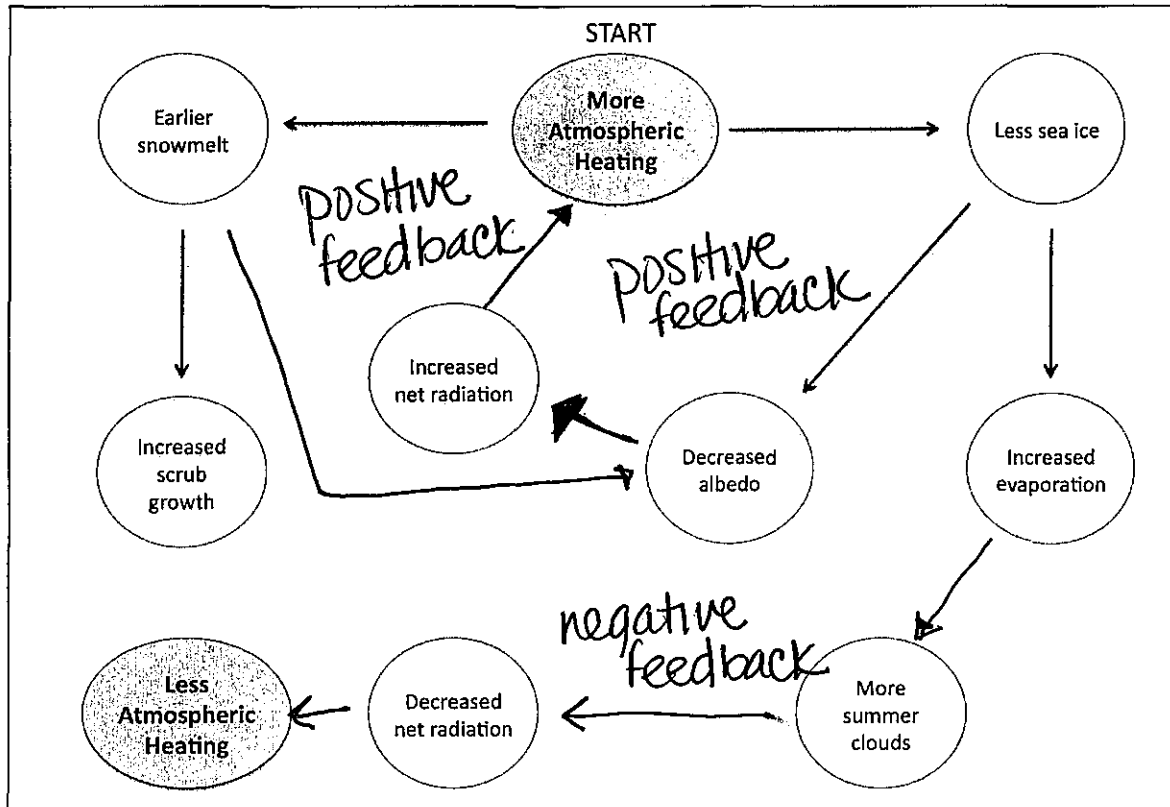
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

It would result in less glaciers and ice sheets, increasing global warming = positive feedback loop.  
Global warming increase = temp increase = decrease in glaciers/ice = more sunlight hitting Earth's surface = increase in infrared heat = increase in temp.

ISP203A – Global Change  
Feedback Loops

11

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.



### Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

### Causal Principles

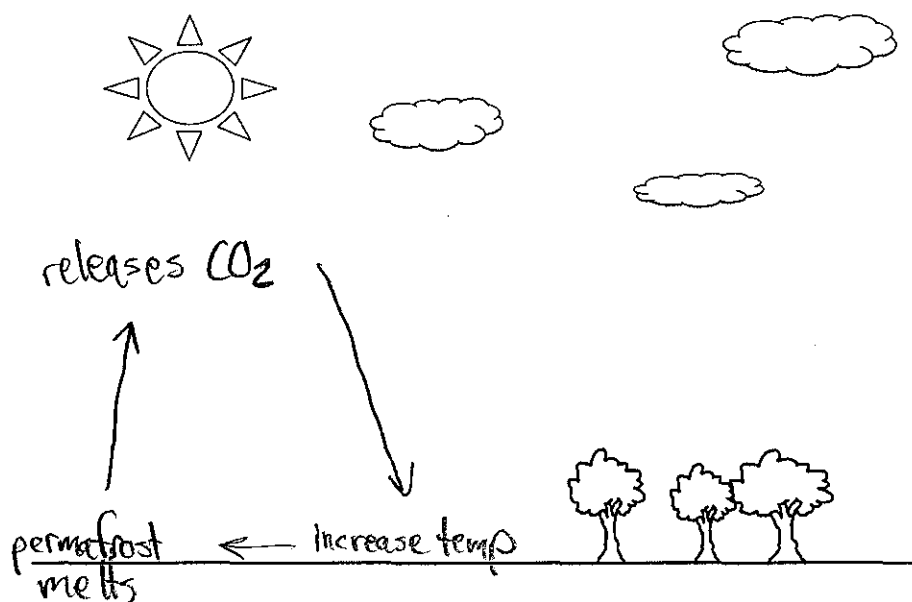
1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

### PART 1: Background Notes

Neg. feedback Ex: Driver trying to stay near the speed limit  
Pos. feedback Ex: Baby crying

### Part 1: Class Work

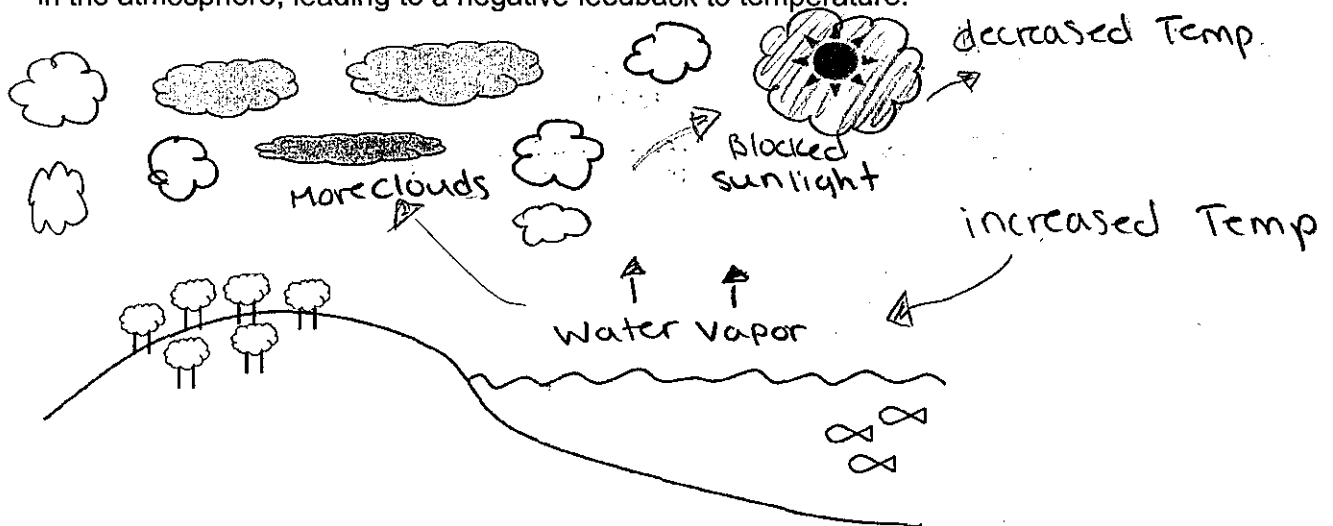
A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



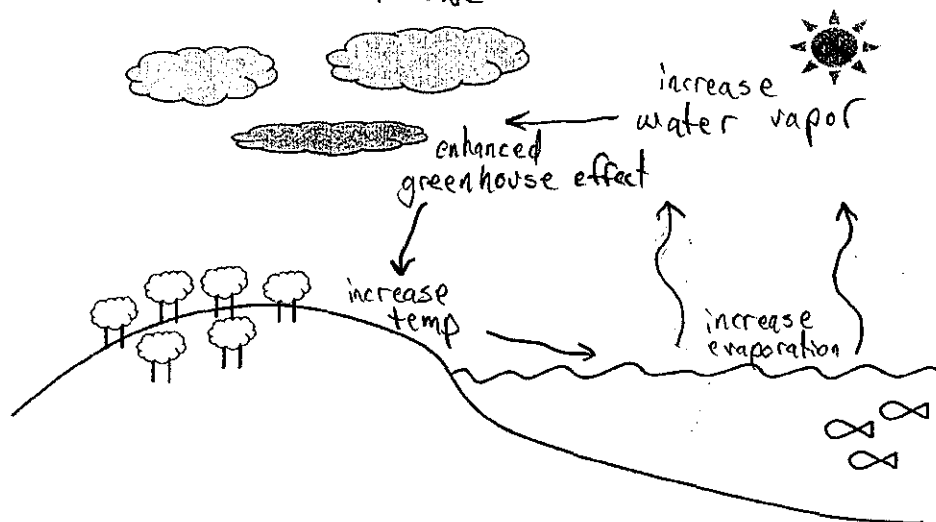
## Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: A change in the system causes further changes in the system such that some component in the system increases overall.
2. Negative feedback: change in a system causes an opposite response in the system such that the system is closer to equilibrium.
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ positive feedback to temperature.





### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Clouds block sunlight reflecting the energy back into space. This then causes a decrease in temp.

B. Which specific step makes this a negative feedback loop?

The increase in clouds.

C. How might cloud cover produce a positive feedback?

If there is an increase in water vapor, this leads to an increase in cloud production. From this, heat is released during this phase change. More heat causes an increase in surface temperature, and then back to an increase in water vapor from evaporation.

### Albedo:

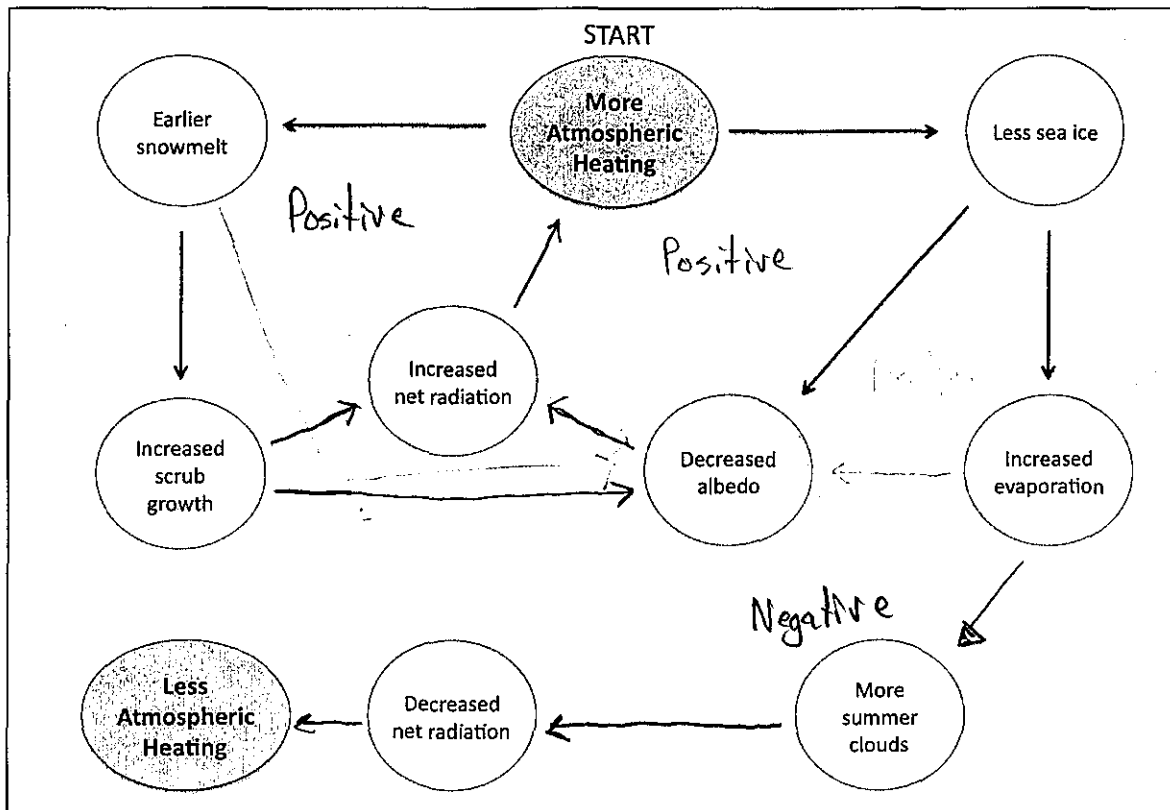
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

A positive feedback loop. This is because a global warming causes the loss of glaciers & ice sheets which reflect the Sun's radiation. If the radiation is being absorbed, then this would result in warming, completing the positive feedback loop.

ISP203A – Global Change  
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

# ISP203A – Global Change Feedback Loops

## Objectives

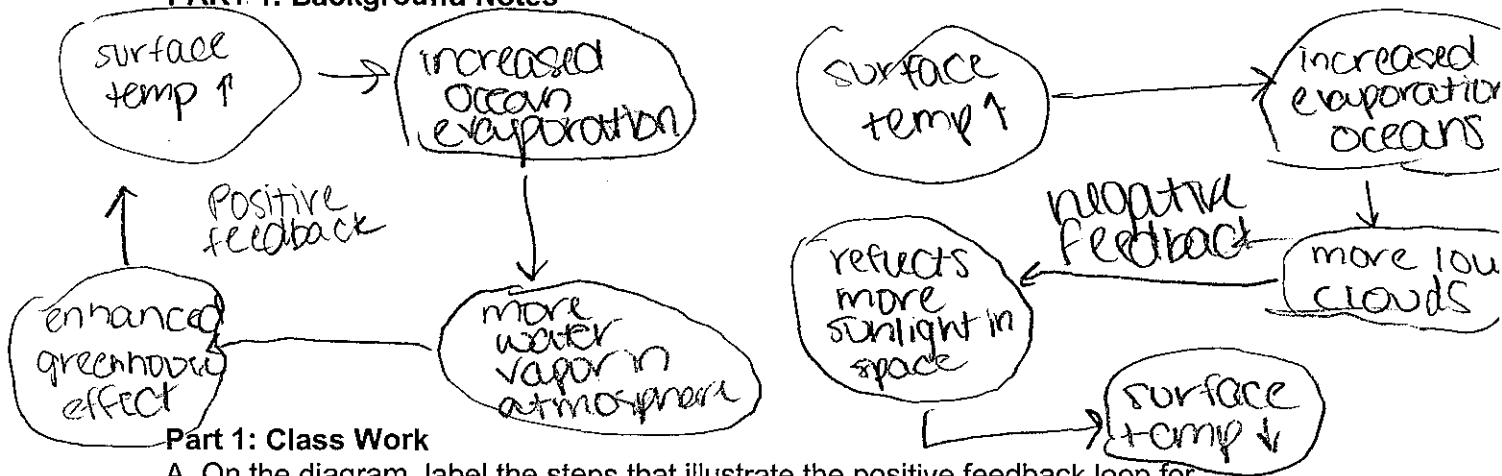
Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

## Causal Principles

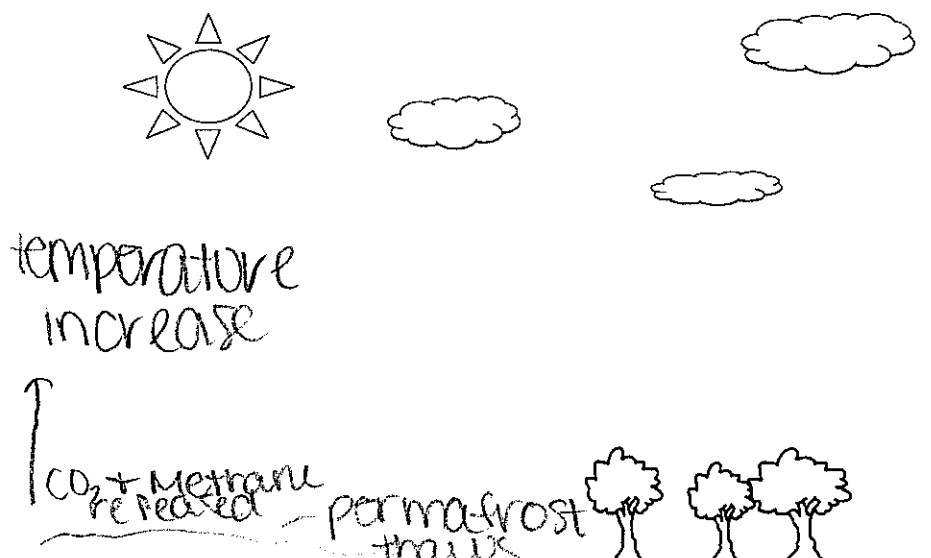
1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

## PART 1: Background Notes



## Part 1: Class Work

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.

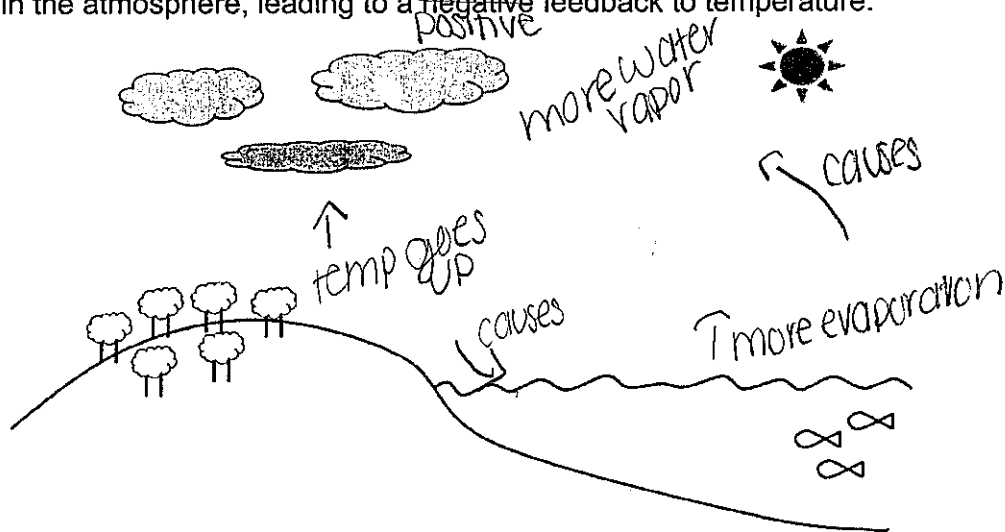


GROUP #: J  
Student IDs of Members Present:  
A43338446  
A42254860  
A42601752

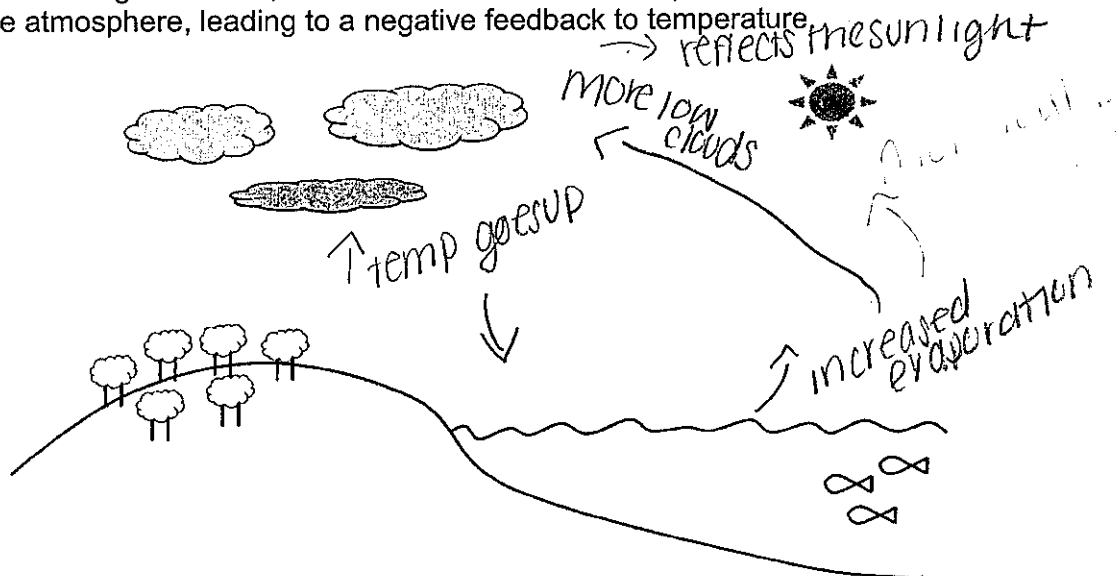
## Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: A change in the system that causes more changes such that a component in the system increases.
2. Negative feedback: a change in a system that causes an opposite effect on other changes.
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



J

### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because the original temperature increase is more than the caused temperature increase.

B. Which specific step makes this a negative feedback loop?

More low clouds being formed leads to extra sunlight to be blocked, so there is less production of infrared light from absorbed sunlight.

C. How might cloud cover produce a positive feedback?

Cloud cover could produce a positive feedback because when the water molecules bond after being evaporated, energy is released. The energy is thermal energy, which adds more heat to

**Albedo:** the atmosphere.

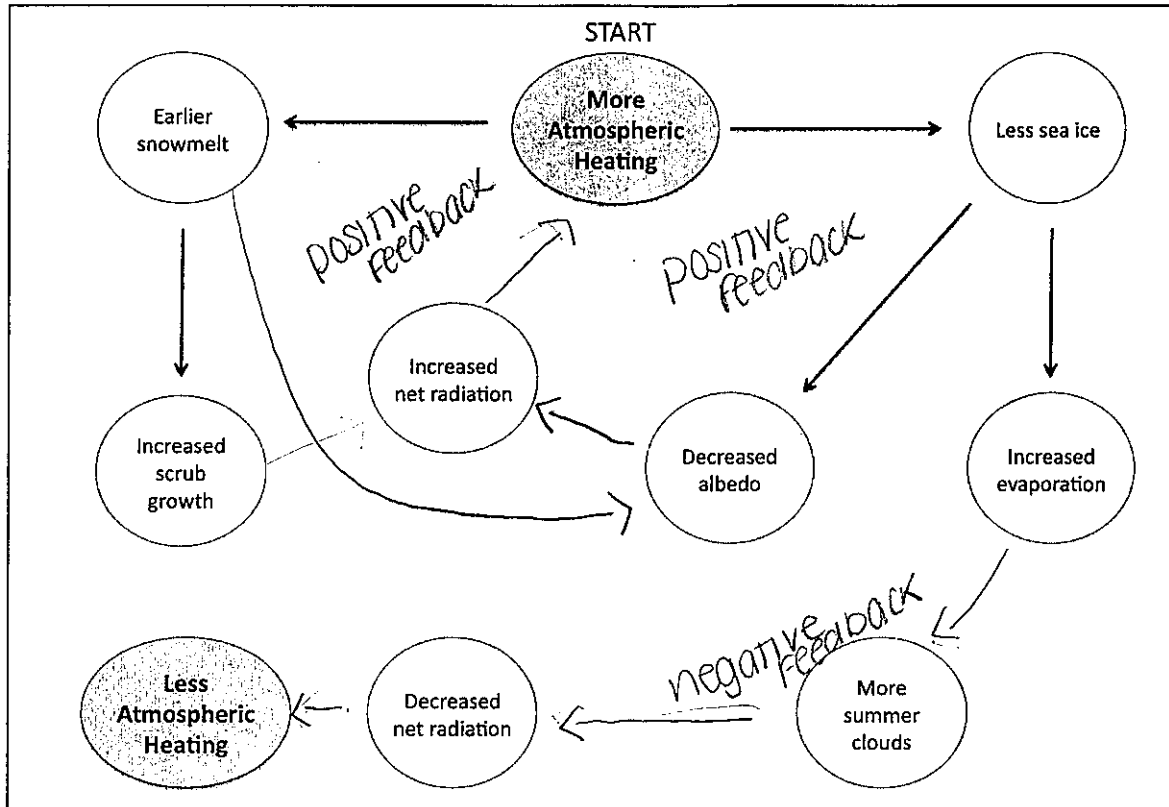
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

If more ice melts, there is more of the earth's surface area that is absorbing sunlight. This leads to an increase in temp because the sunlight is converted to more thermal energy released back into the atmosphere. Higher temps lead to more evaporation, which leads to even warmer temperatures, causing ice to melt. The increase in ice melting at the end shows how it is a positive feedback.

## ISP203A – Global Change Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

The low clouds that form block sunlight so that more is reflected instead of absorbed. This means that it tries to bring the amount of thermal energy in the atmosphere back to equilibrium.

- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Less sea ice from temperature/atmospheric heating leads to less surfaces to reflect sun, so there is increased net radiation from more sun being absorbed and changed to thermal energy, which leads to more temperature increases.



ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

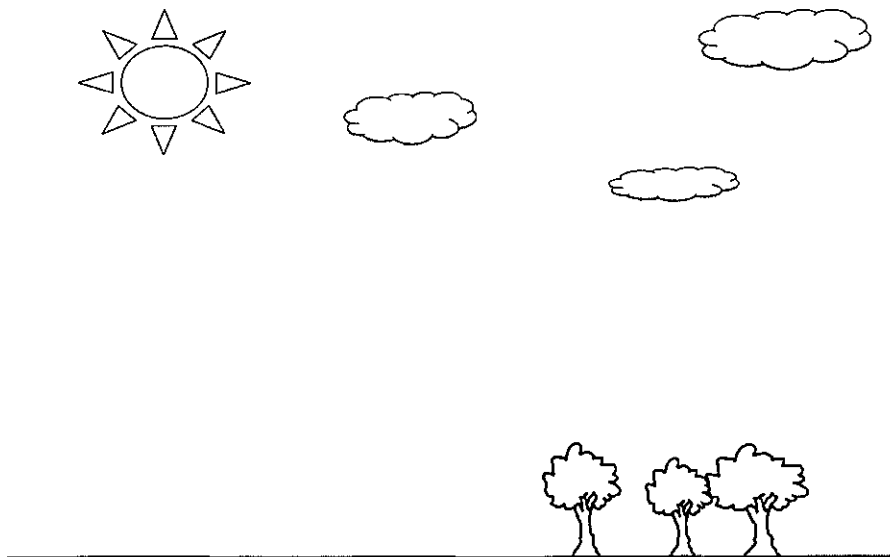
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

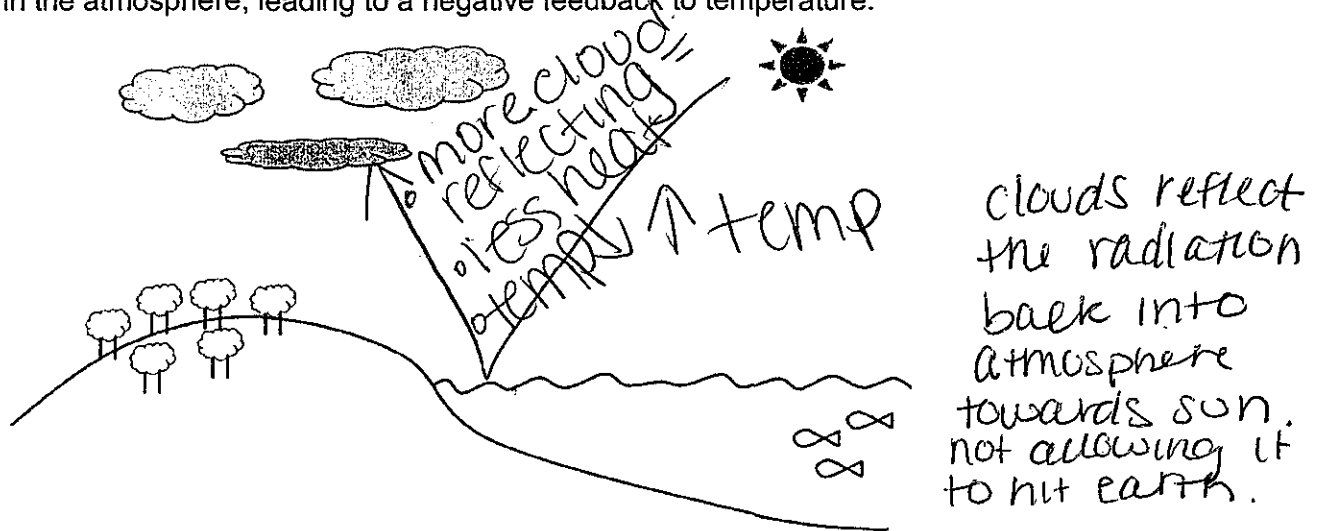
A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



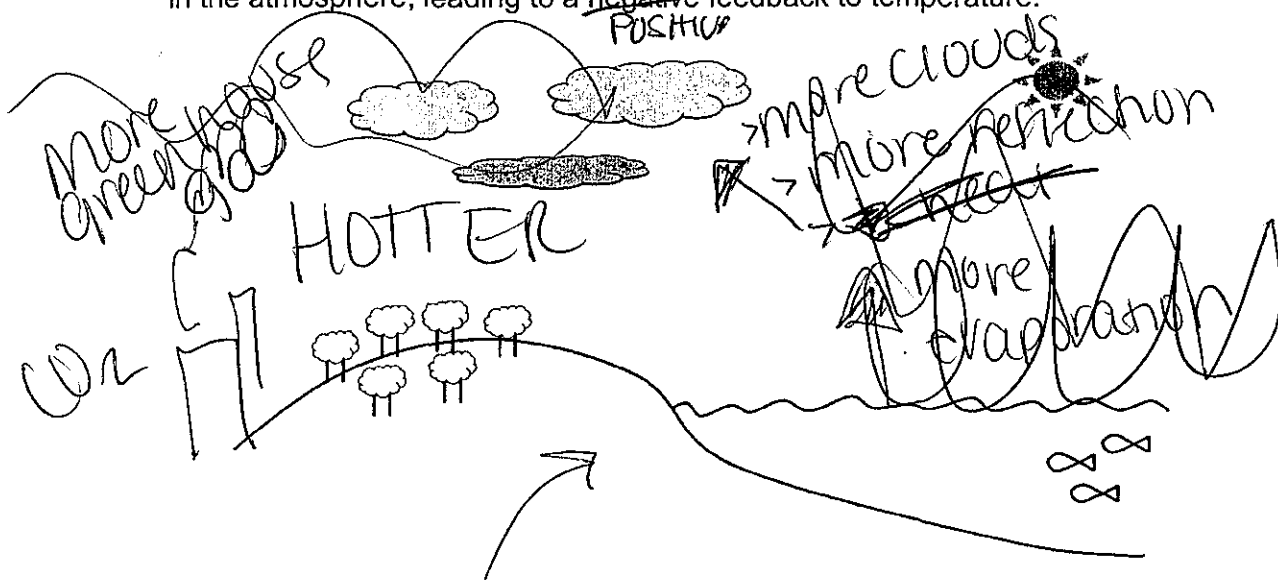
### Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback:  
a change in the system causes an increase in the system
2. Negative feedback:  
An event causes events that causes less of the same
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

It ↓ temp of earth it reflect sunlight away from earth Atmosphere.

B. Which specific step makes this a negative feedback loop?

Clouds Reflecting the evaporation causing more water vapor, which condenses into more clouds.

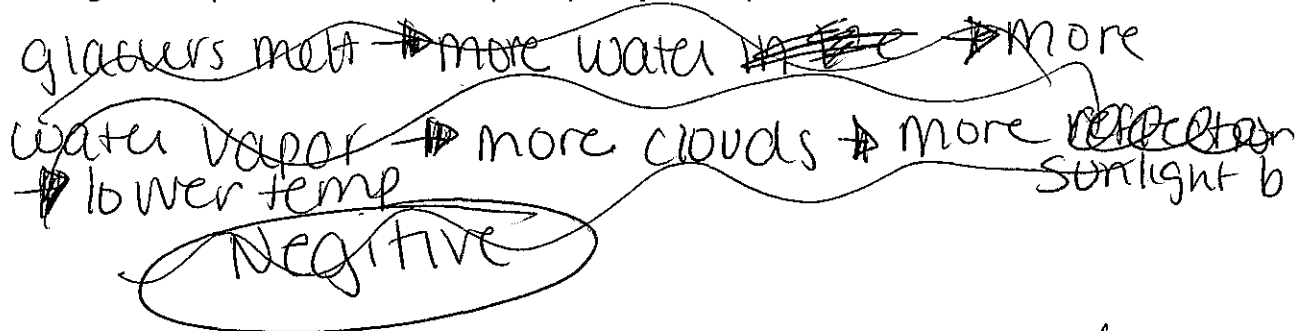
C. How might cloud cover produce a positive feedback?

MORE Water Vapor to hold radiation in atmosphere causing temp increase.

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.



once the glaciers melt, the earth would be able to absorb the energy change into infra red sending in back into the atmosphere causing the temp to increase causing a positive feedback.

## K

K



K

- K

K

K

ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

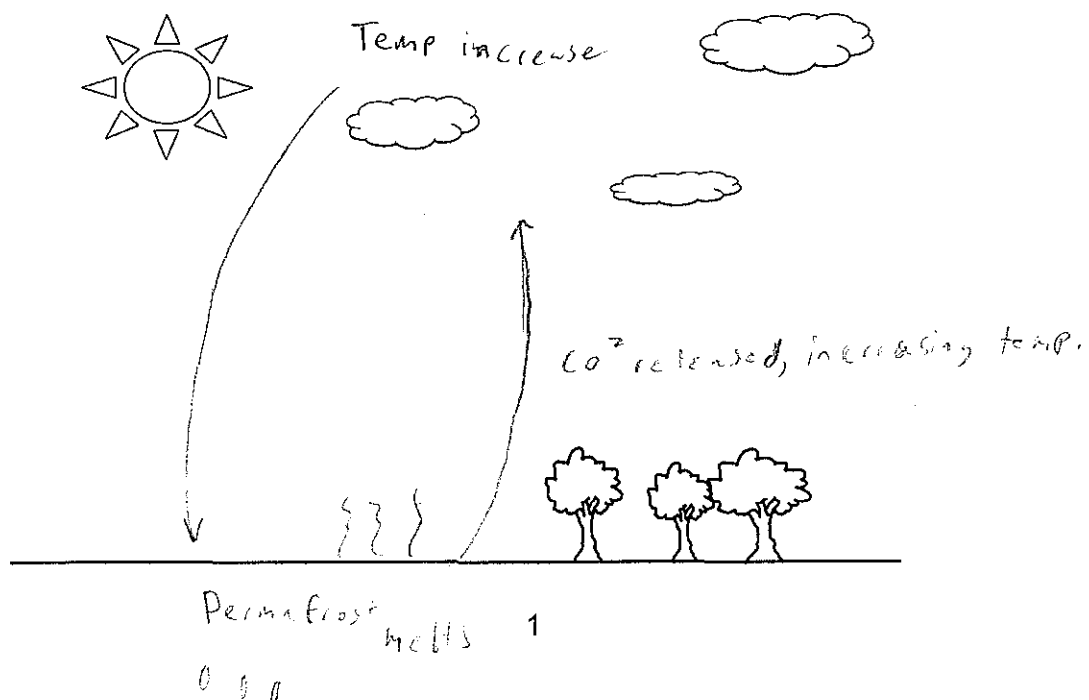
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



A42204525

ISP203A – Global Change  
Feedback Loops

GROUP #: L

Student IDs of Members Present:

~~\_\_\_\_\_~~ A41439593

~~\_\_\_\_\_~~ A43449318

~~\_\_\_\_\_~~ A42065731

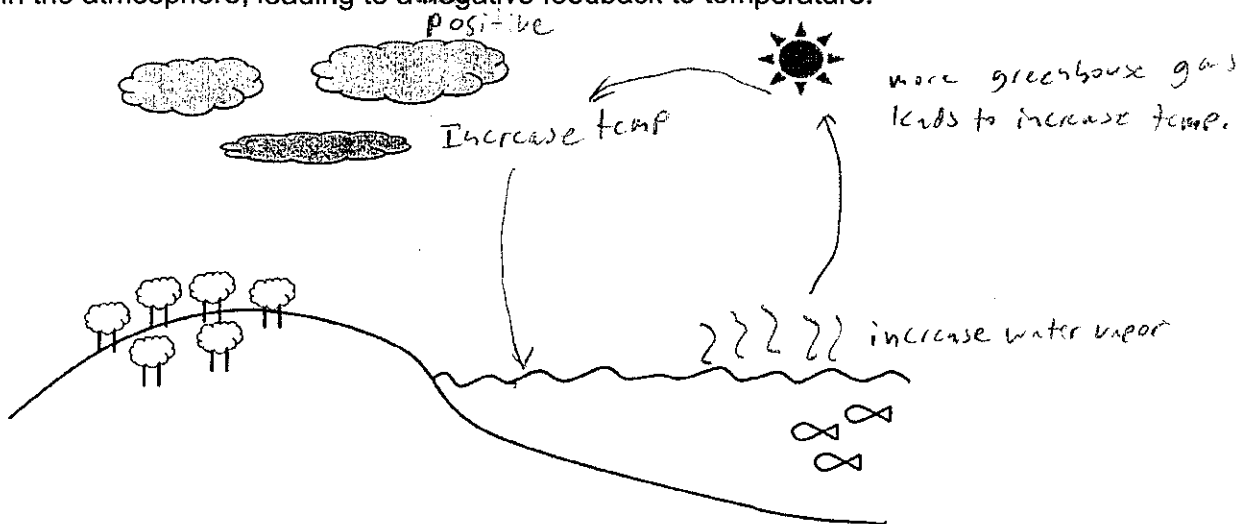
Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

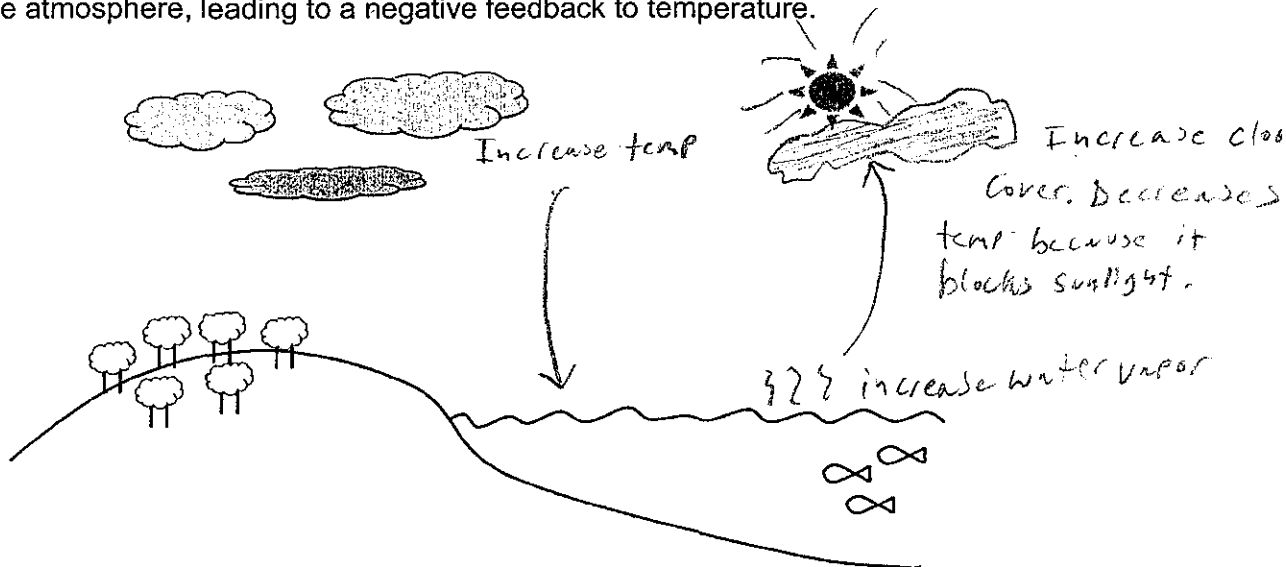
1. Positive feedback: Cause causes event which causes more of the same event.

2. Negative feedback: Cause causes event which causes an opposite event.

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Cloud cover blocks the sun and decreases temperature.

B. Which specific step makes this a negative feedback loop?

Temperature goes up less.

C. How might cloud cover produce a positive feedback?

clouds forming releases energy in form of heat which increases temperature.

### Albedo:

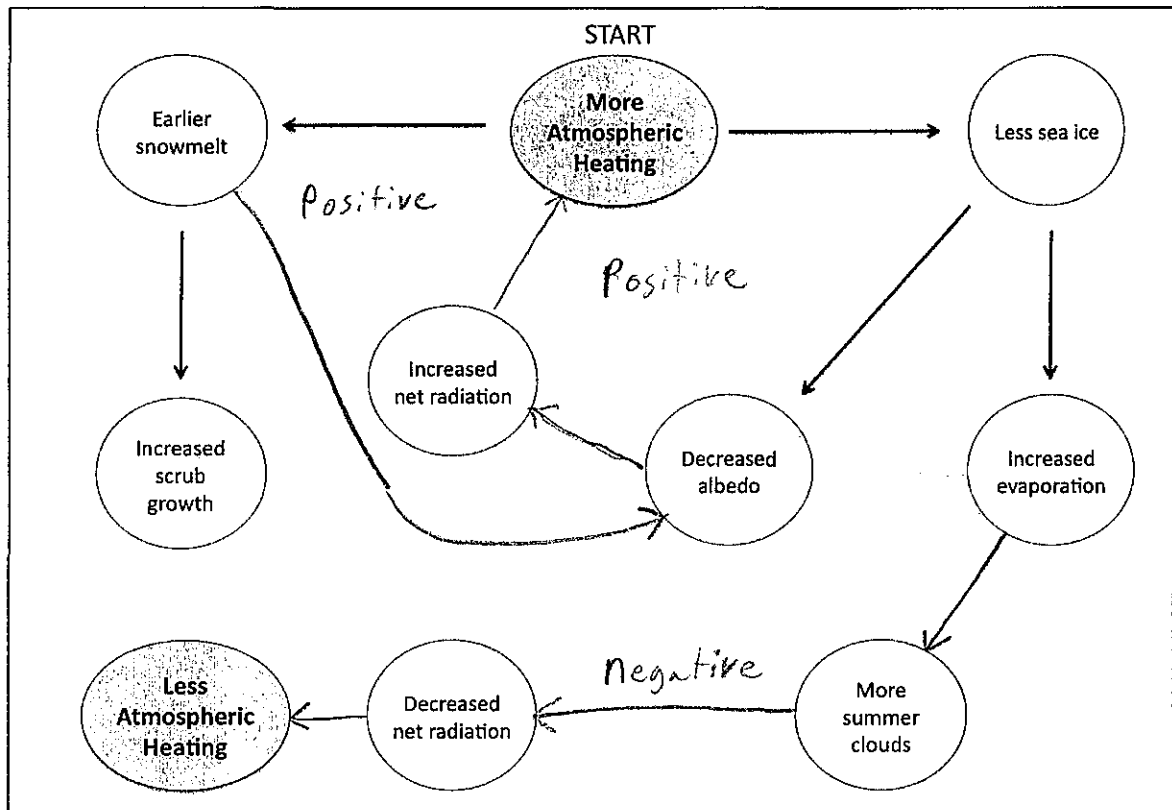
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive feedback loop because less glaciers reflect sunlight and the earth absorbs more heat, increasing temperature.

## ISP203A – Global Change Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

Heat causes less sea ice, but because less sea ice causes more clouds and decreases temperature, it gets closer to equilibrium.

- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Heat increase causes less sea ice and because it decreases albedo, it increases temperature and brings it further from equilibrium.



ISP203A – Global Change  
Feedback Loops

M

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

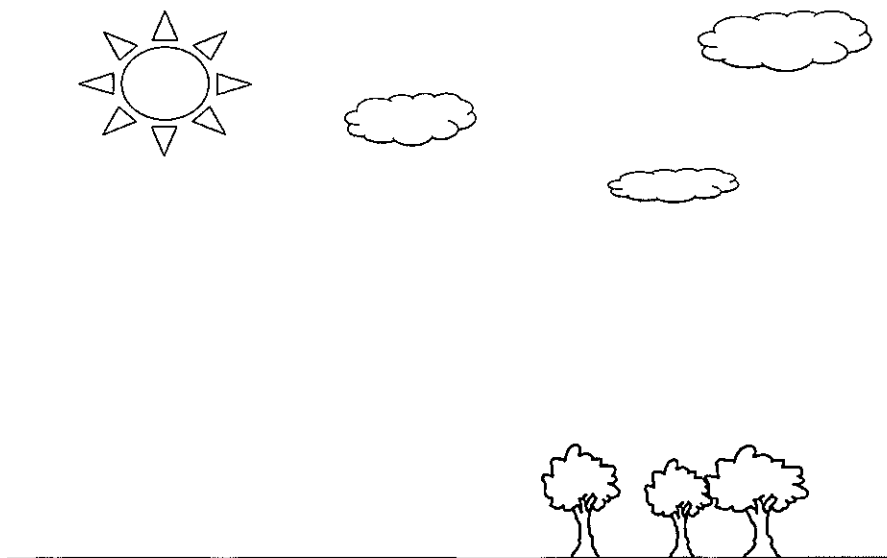
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



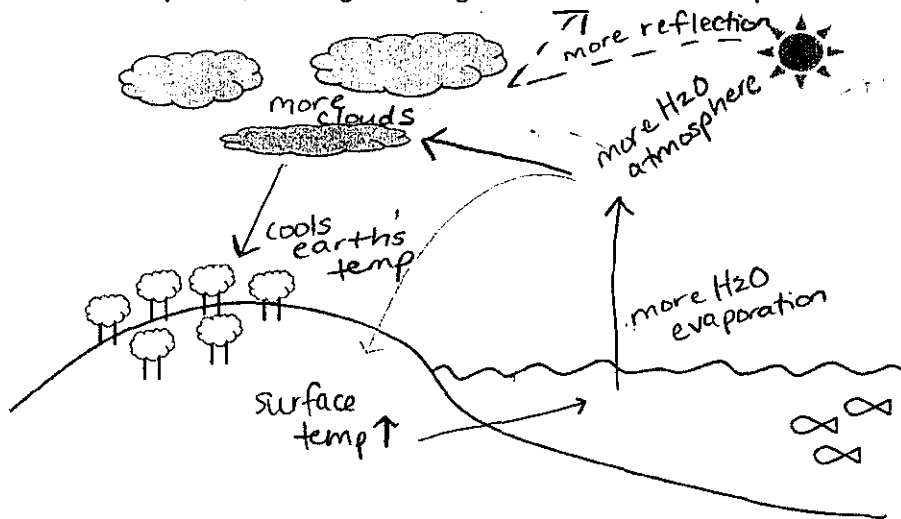
## Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

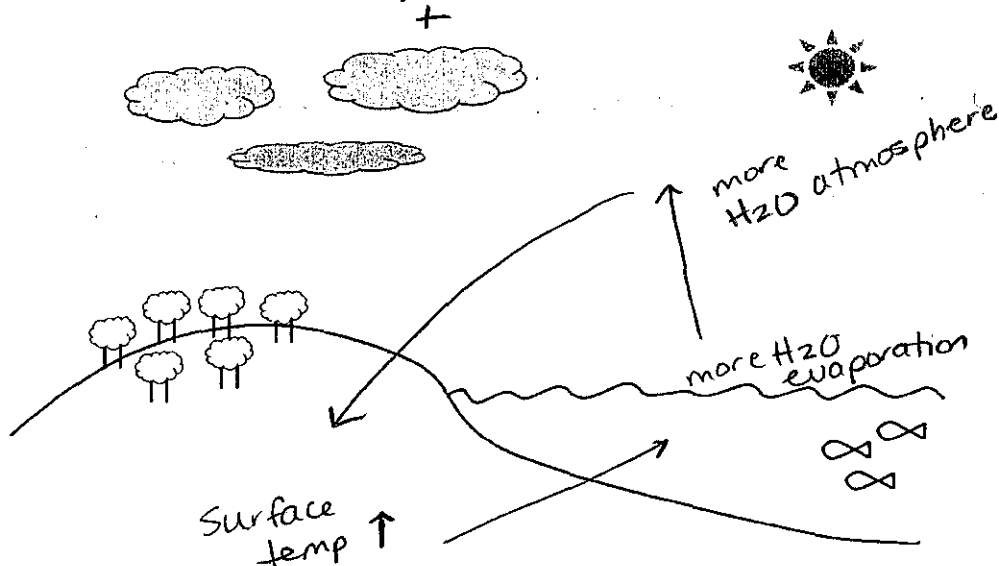
1. Positive feedback: *a change that causes further change in the same direction*

2. Negative feedback: *a change that causes change back toward equilibrium*

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ **positive** feedback to temperature.



M

### Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?  
as surface temperature increases, more H<sub>2</sub>O is evaporated out of oceans, which increases the amount of H<sub>2</sub>O vapor in atmosphere. This "creates" more clouds, which reflect sunlight and cools the earth's temperature
- B. Which specific step makes this a negative feedback loop?  
The increased temperature causes a decrease in temperature
- C. How might cloud cover produce a positive feedback?  
Temperature increases, which causes more evaporation, which could cause more clouds to form, which would allow more radiation to get trapped and reflected back which would cause temp. to increase

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

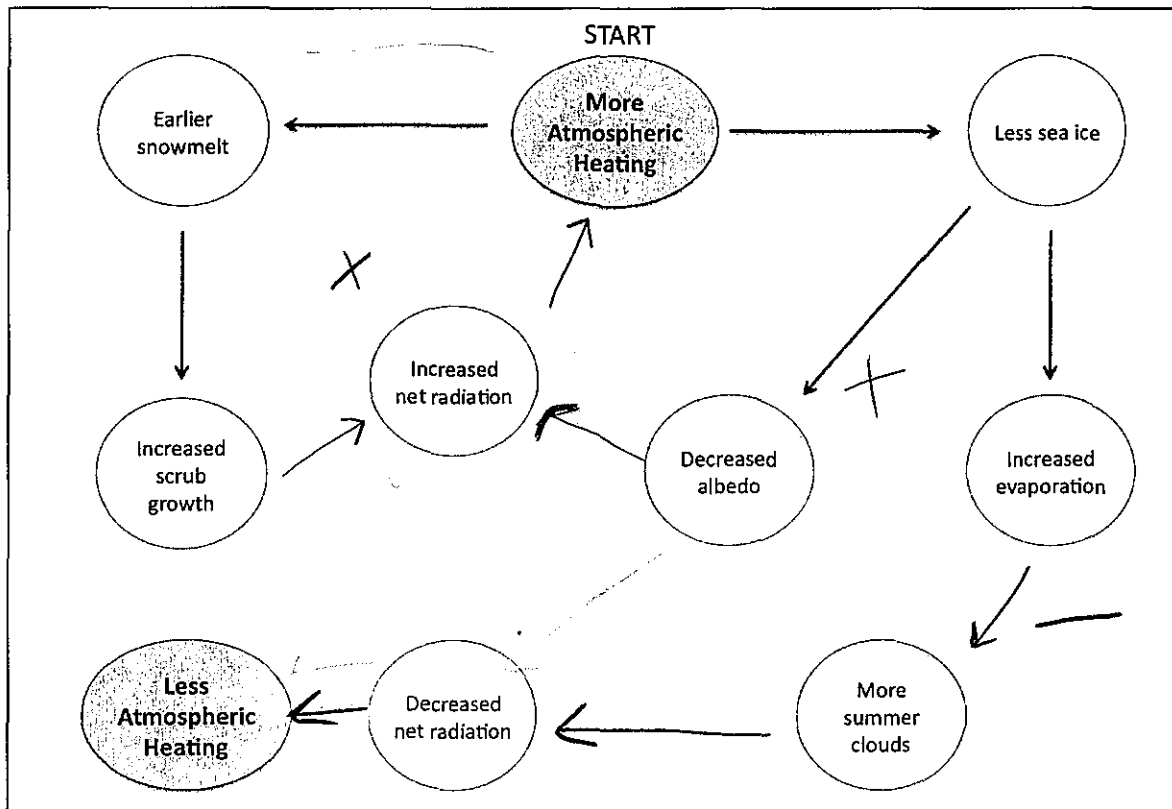
- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive — warmer temp. cause more glaciers/ice sheets to melt, which gives the surface less albedo, which causes the earth to absorb more radiation, which  
↑ temp.

ISP203A – Global Change  
Feedback Loops

M

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

more atmospheric heating causes melting of ice, which increases evaporation, which causes more clouds to form, which reflects sunlight causing decreased net radiation which leads to less atmospheric heating

- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

more heating leads to more snow melting, which causes increased scrub growth, which absorbs more radiation from sun (↑ net radiation) which causes more atmospheric heating

ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

**Causal Principles**

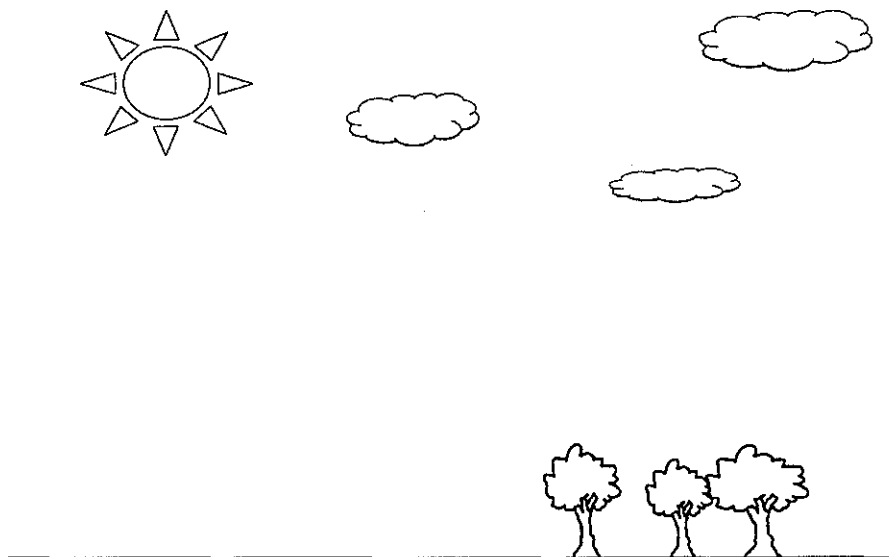
1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

Positive - something causes an enhanced reactions of something else. Change in a system causes further changes in a system. some component increases.  
Negative - a change in a system causes an opposite response in the system such that the system is closer to equilibrium.

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



GROUP #: N  
Student IDs of Members Present:  
A42669593  
A4107889

### Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

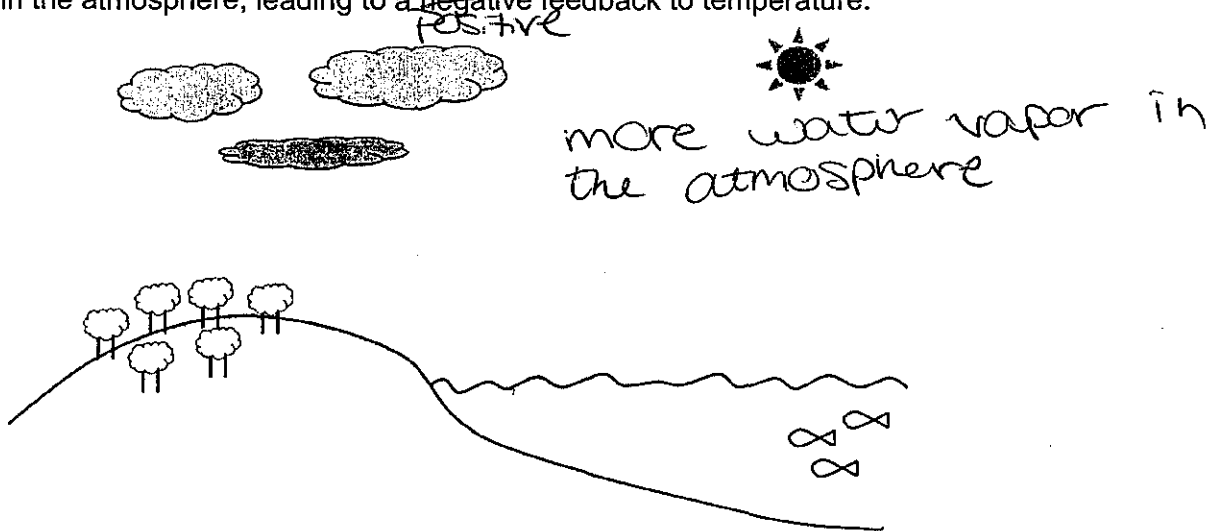
1. Positive feedback:

changes in a system causes further changes in the system

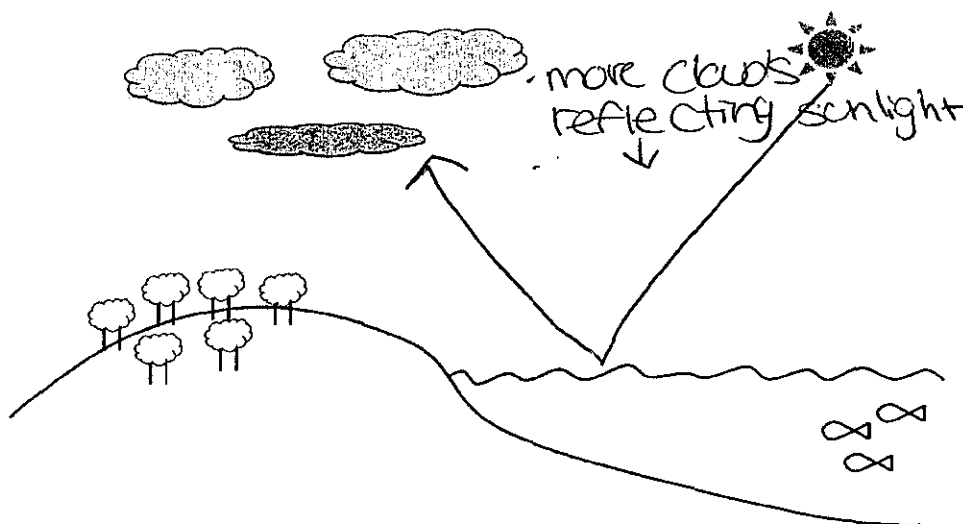
2. Negative feedback:

an event causes events that causes less of the same

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





### Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?  
because the clouds stop the sunlight from being reflected back into the atmosphere
- B. Which specific step makes this a negative feedback loop?  
clouds reflecting sunlight
- C. How might cloud cover produce a positive feedback?  
by ~~holding~~ more water vapor holding sunlight in the atmosphere which causes temp to increase

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

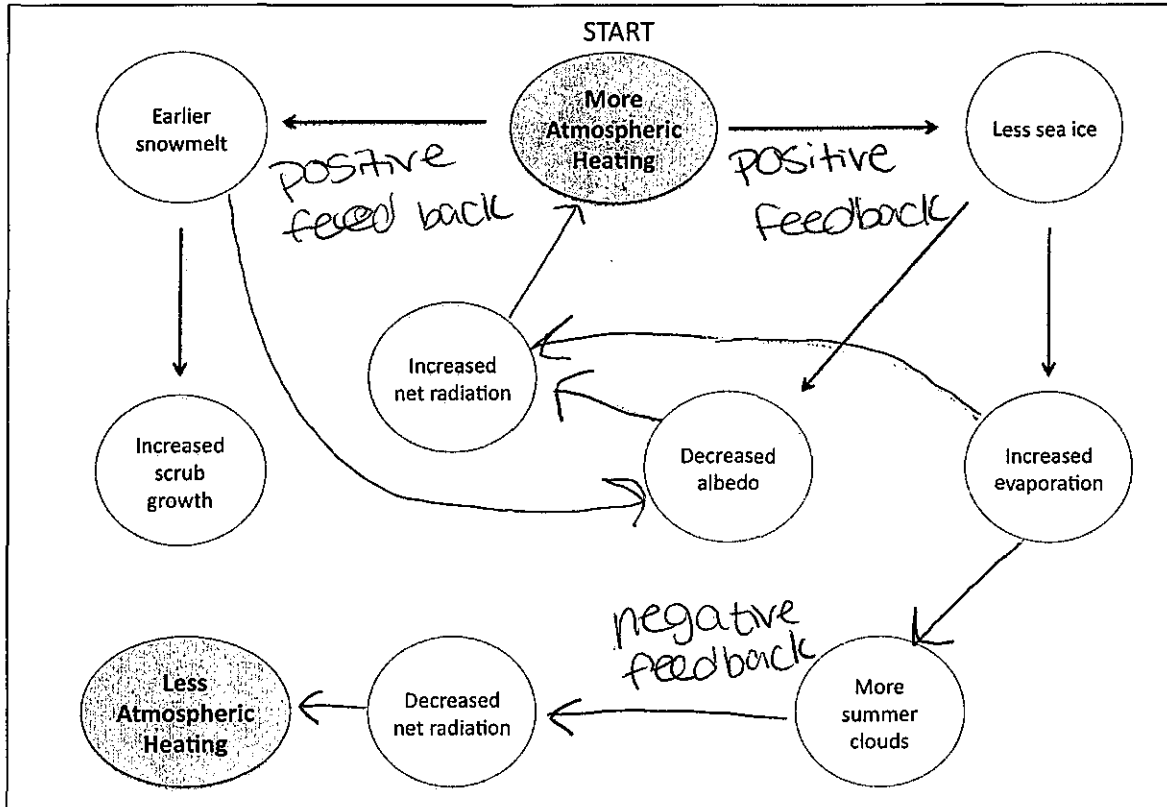
- D. If global warming causes the loss of glaciers and ice sheets, would this result in a ~~negative~~ positive feedback loop? Explain your response.

once the glaciers melt, the earth would absorb the energy change into infra red sending it back into the atmosphere causing the temp to increase causing a positive feedback

# ISP203A – Global Change Feedback Loops



On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

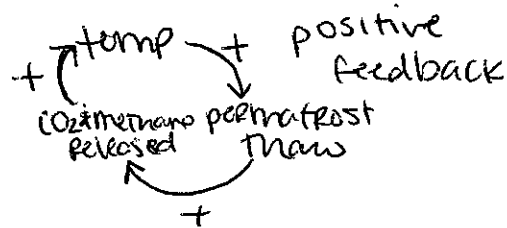
more water vapor  
cools earth after its heated

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

methanes put into the atmosphere  
→ more greenhouse gases holds  
the heat in longer



# ISP203A – Global Change Feedback Loops



## Objectives

Upon completion of this activity, you will be able to:

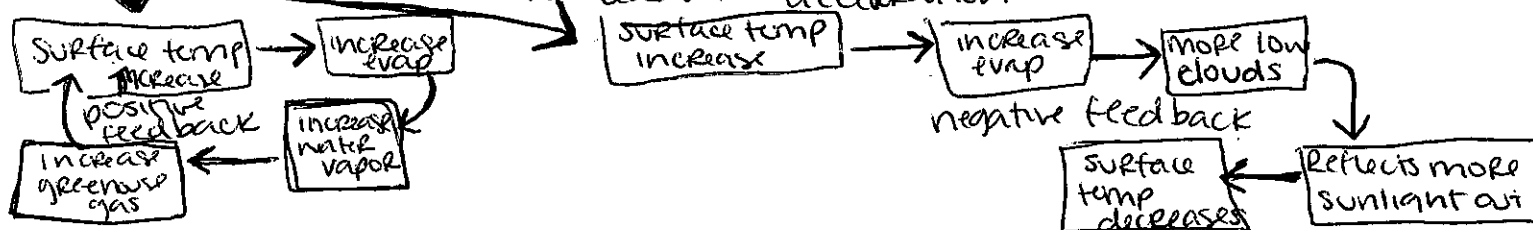
- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

## Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

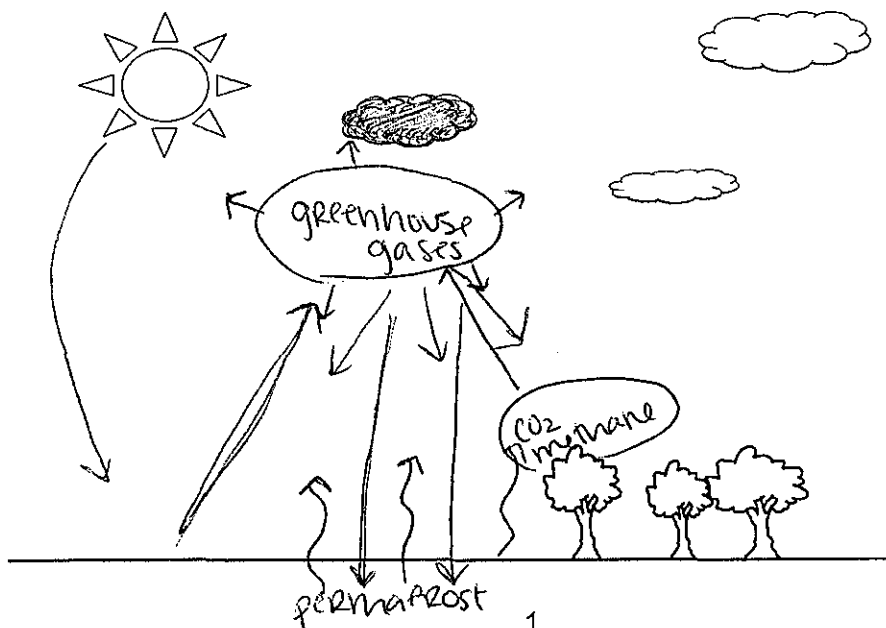
## PART 1: Background Notes

positive feedback: change in system causes more change in system, some component in system increases overall.  
negative feedback: change occurs system reacts & moves back toward equilibrium ex) body temp ↑ → sweating → body temp ↓  
 deceleration leads to acceleration



## Part 1: Class Work

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



GROUP #: ①  
Student IDs of Members Present:  
A43643320 A34590917  
A41096642  
A41262816

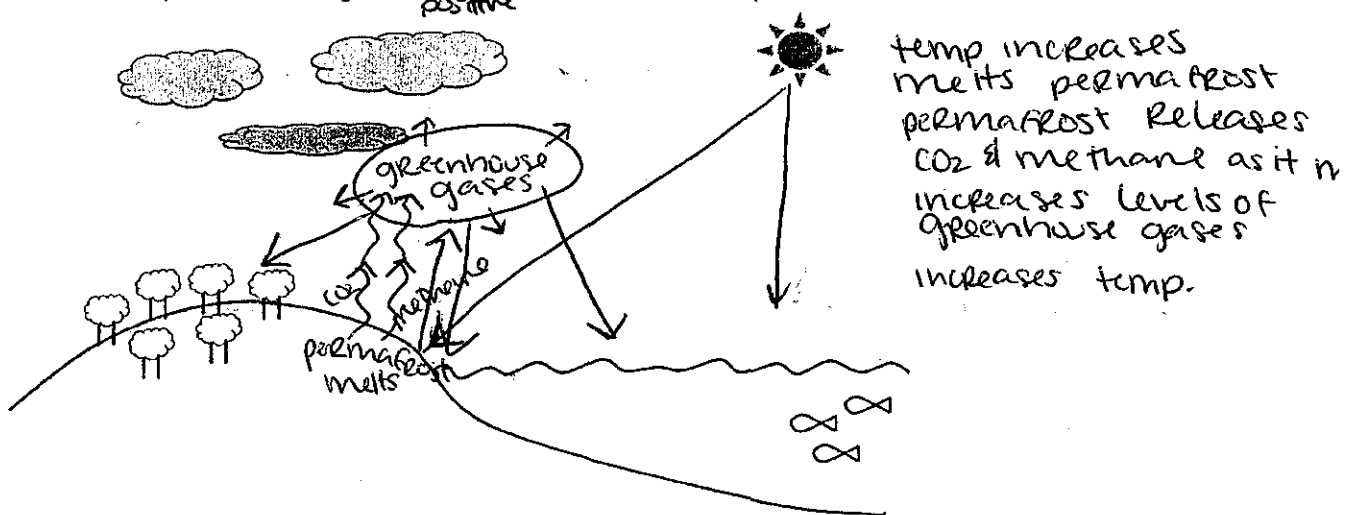
## Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

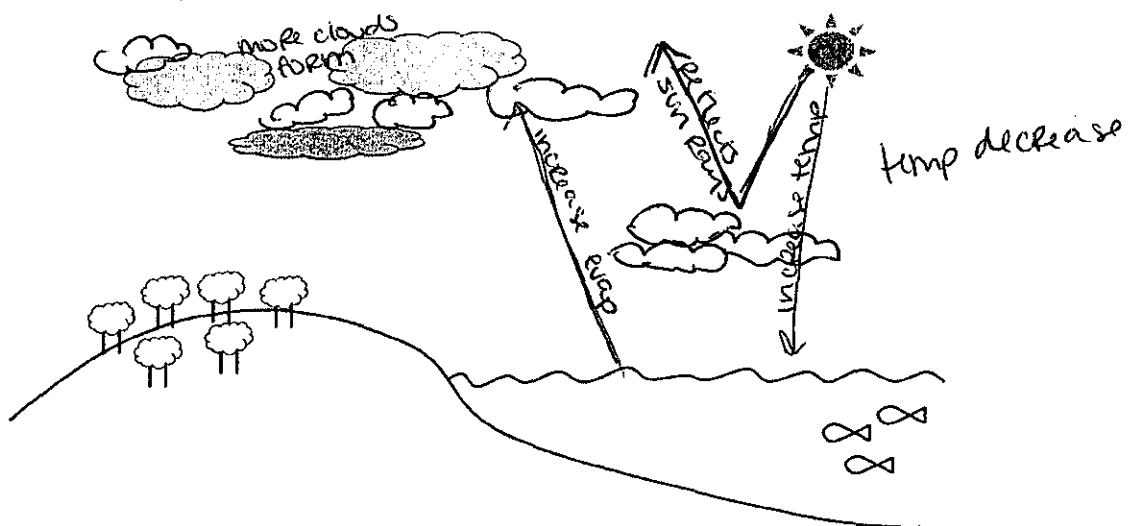
1. Positive feedback: change in an event leads to more changes that increase said event.

2. Negative feedback:

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a positive feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

cloud cover blocks some of the incoming sunlight which leads to less infrared & causes temperature to go down.

B. Which specific step makes this a negative feedback loop?

The fact that clouds form & block infrared light & lowers temperature makes it a negative feedback loop.

C. How might cloud cover produce a positive feedback?

The production of clouds produces more clouds which leads to an increase in temperature which then allows more clouds to be produced.

### Albedo:

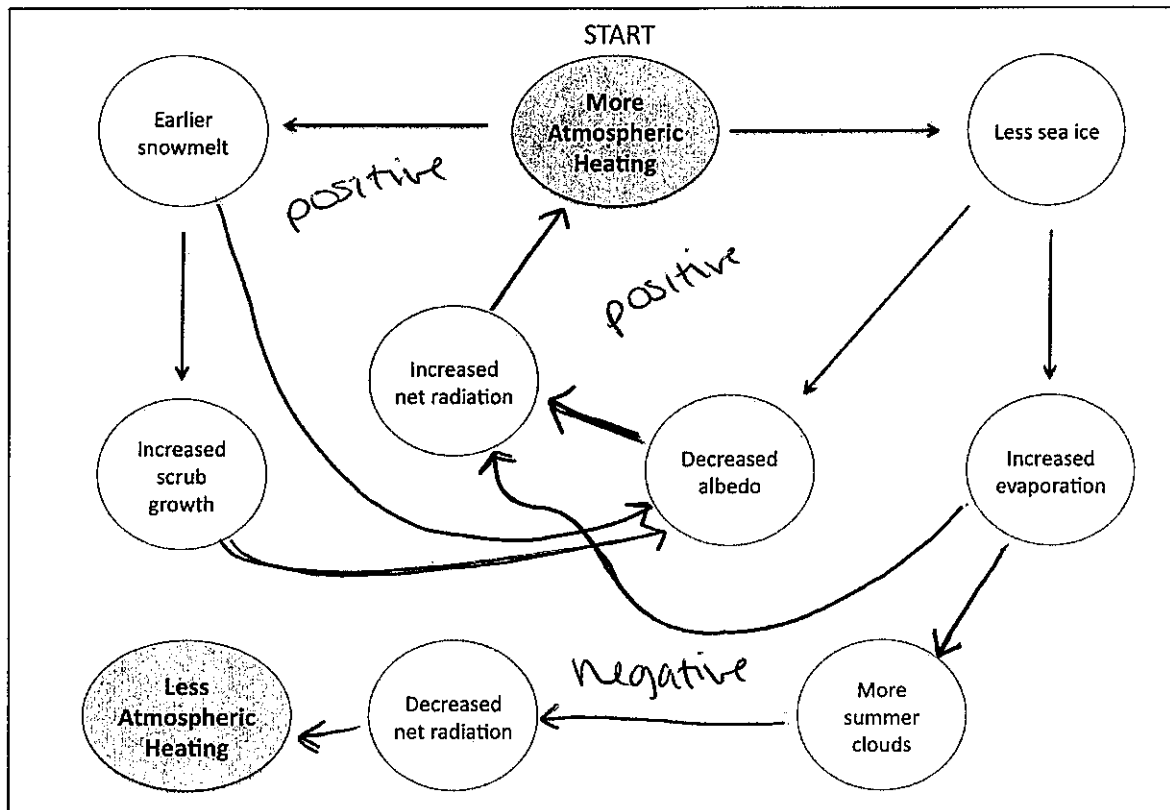
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

It would create a positive feedback because the increase in temp would cause ice to melt which would decrease the albedo effect & which would increase radiation & increase the temperature ~~set~~.

## ISP203A – Global Change Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium. if the temp goes up the ice melts & increases evaporation which creates clouds & decreases radiation & decreases temperature allowing the temperature to go back closer to a state of equilibrium.
- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium. an increase of temp increases melting of ice which decreases albedo & increases radiation which increase temp making the temperature further from equilibrium

ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

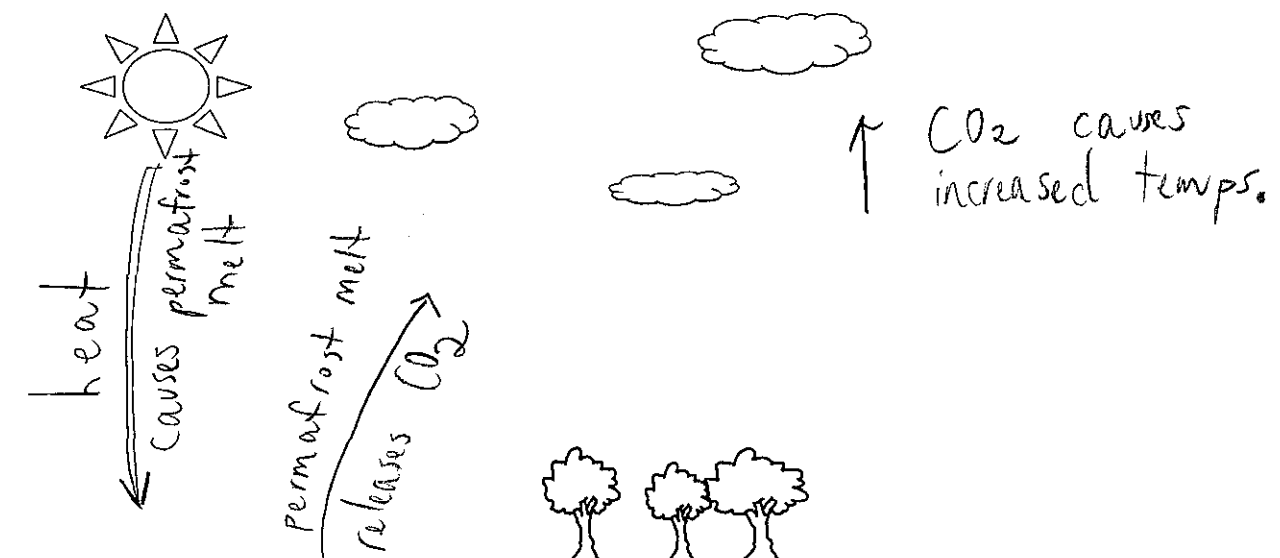
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



GROUP #: P  
Student IDs of Members Present:  
A39800329  
A40543777

### Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

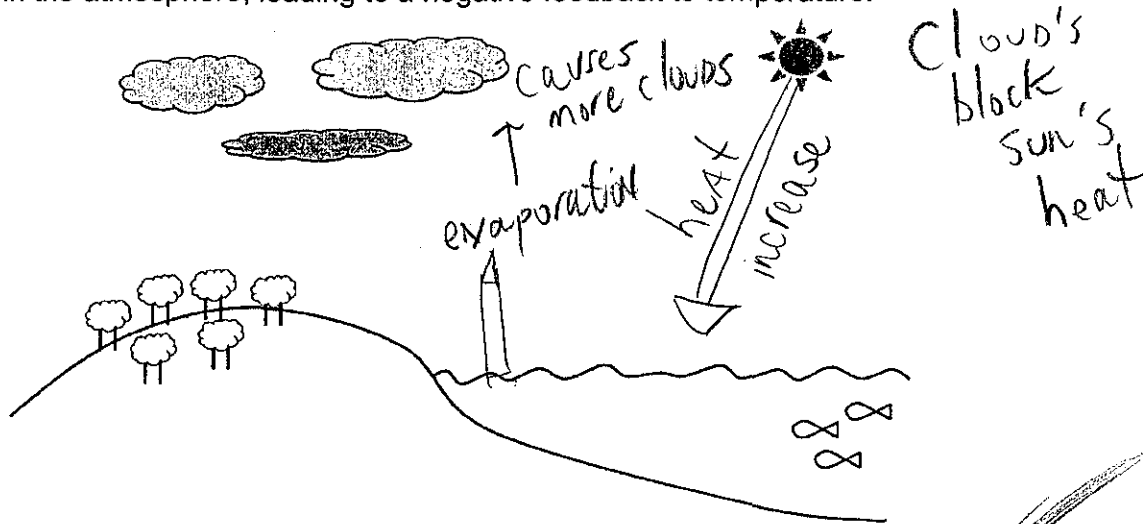
1. Positive feedback:

An event causes event that causes more of the same.

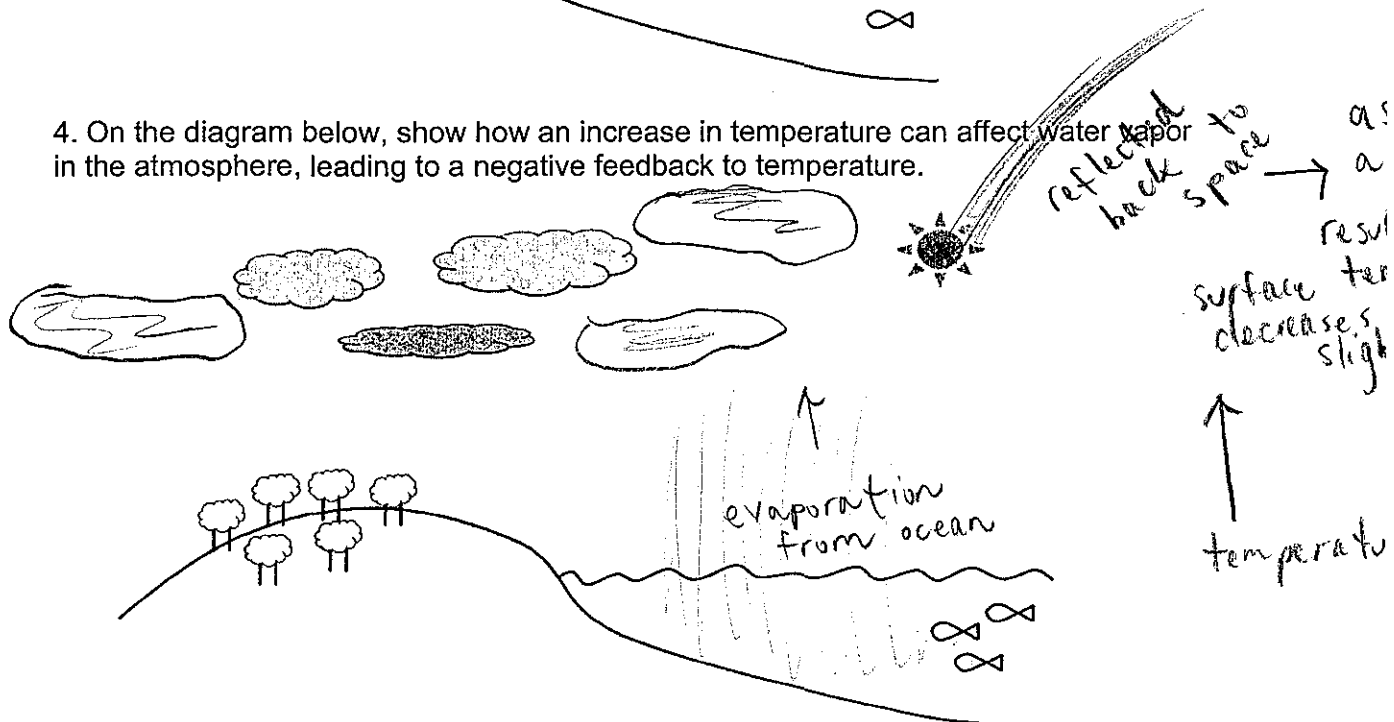
2. Negative feedback:

An event causes event that cause less of the same event.

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



**Questions**

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Clouds cause sunlight to be blocked which causes less production of infrared which causes less temperature increase (negative feedback).

B. Which specific step makes this a negative feedback loop?

The blocking of the sun causes the overall negative temperature increase.

C. How might cloud cover produce a positive feedback?

The creation of heat from the clouds creates an overall increase in heat (positive feedback).

**Albedo:**

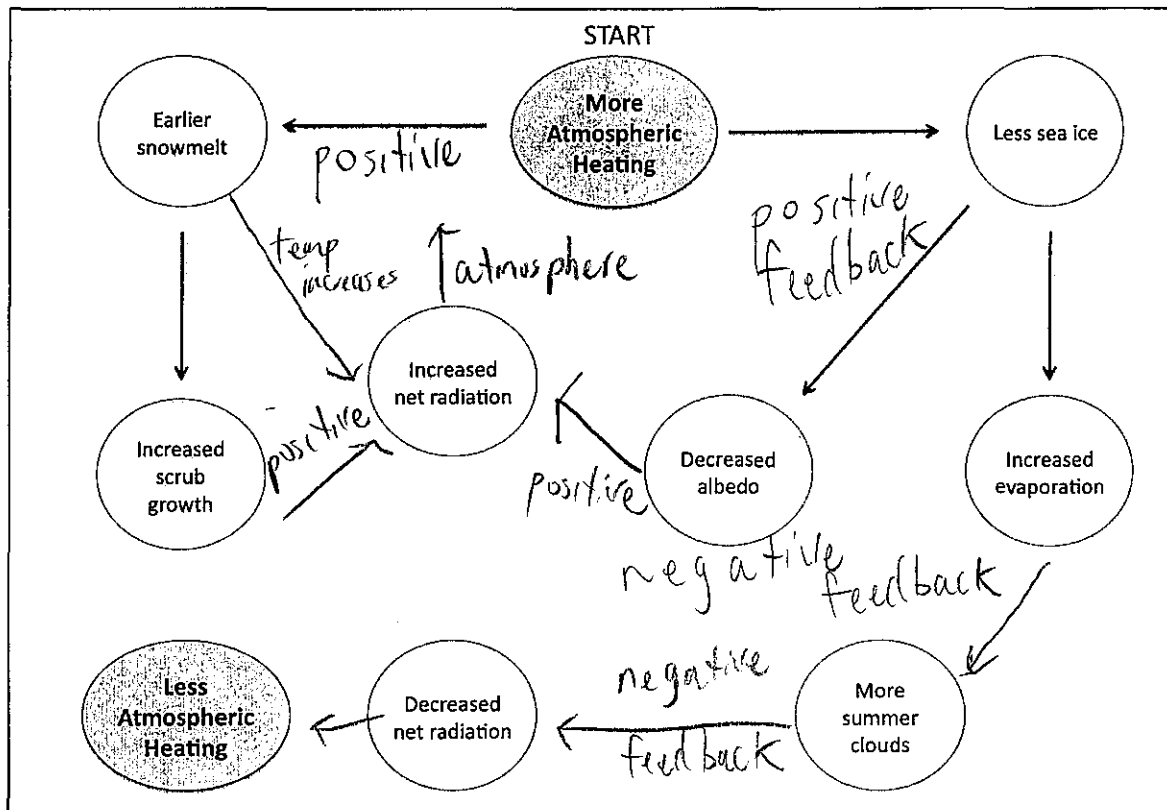
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive because when there is less ice, more radiation is absorbed, and temperature keeps rising.

## ISP203A – Global Change Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More heating causes less sea ice which causes increased evaporation which causes more clouds, which causes decreased net radiation which causes less atmospheric heating.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.



ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

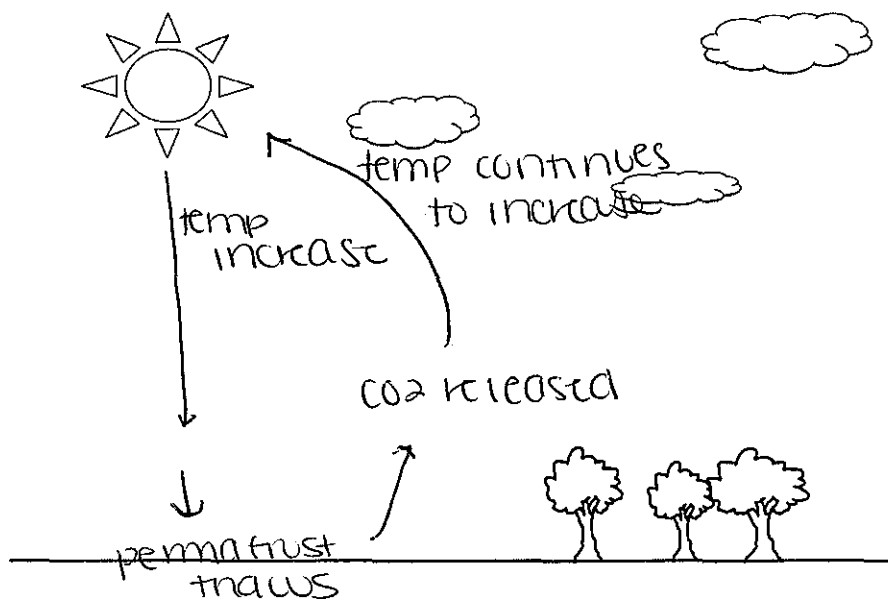
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



**Part 2: Group Work**

Make sure everyone in your group understands these terms before moving on.

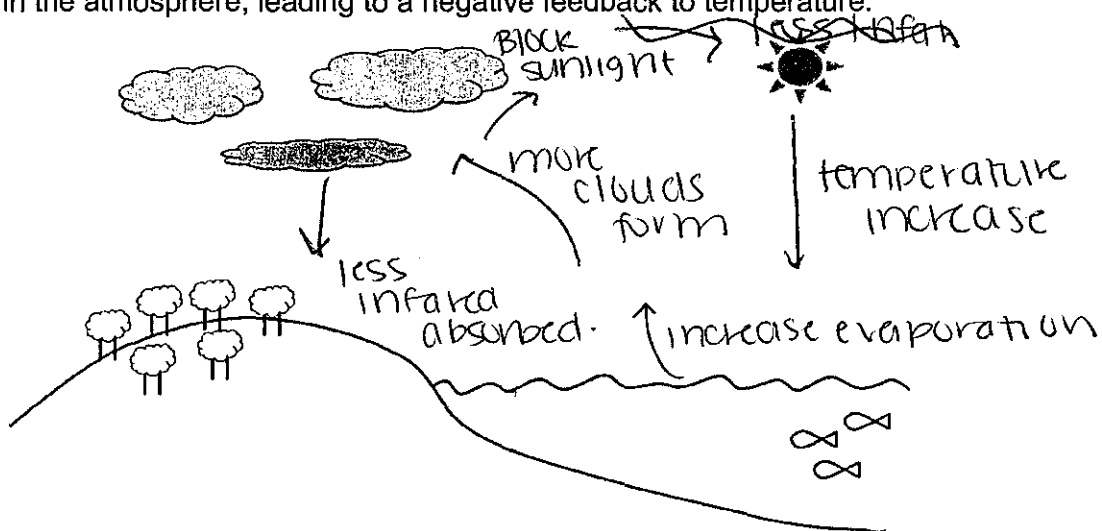
1. Positive feedback:

change causes reaction to further the original change

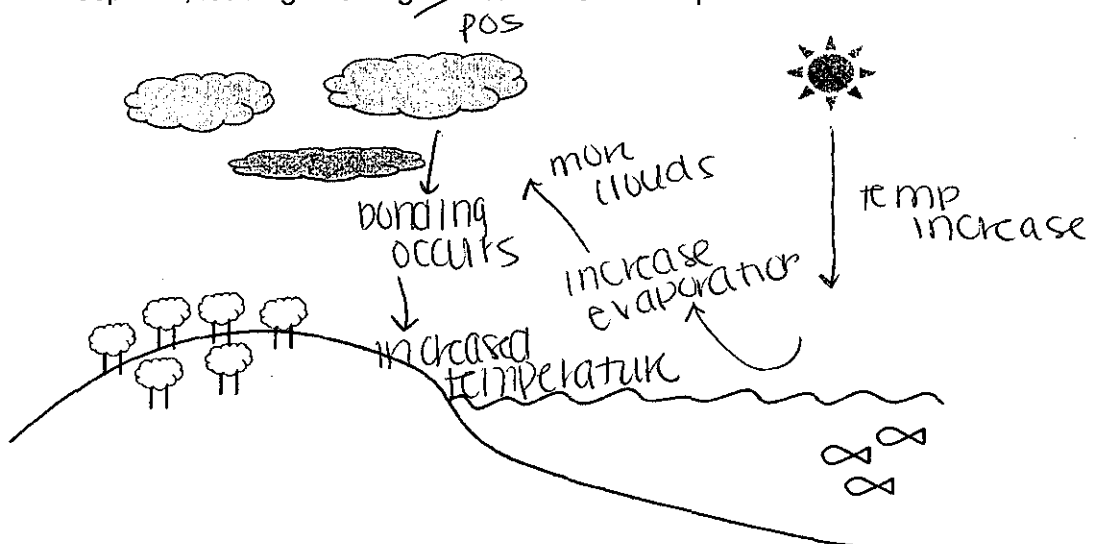
2. Negative feedback:

change occurs, system reacts and moves back toward equilibrium.

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Temperature  $\uparrow$   $\rightarrow$  causes more evaporation which causes more clouds to form which causes sunlight to be blocked, which causes less light to be absorbed,

B. Which specific step makes this a negative feedback loop? causes a decrease in temperature.  
Blocking of sunlight

C. How might cloud cover produce a positive feedback?

because when a cloud is formed and bonds are created, which releases heat  $\rightarrow$  increased temperature.

### Albedo:

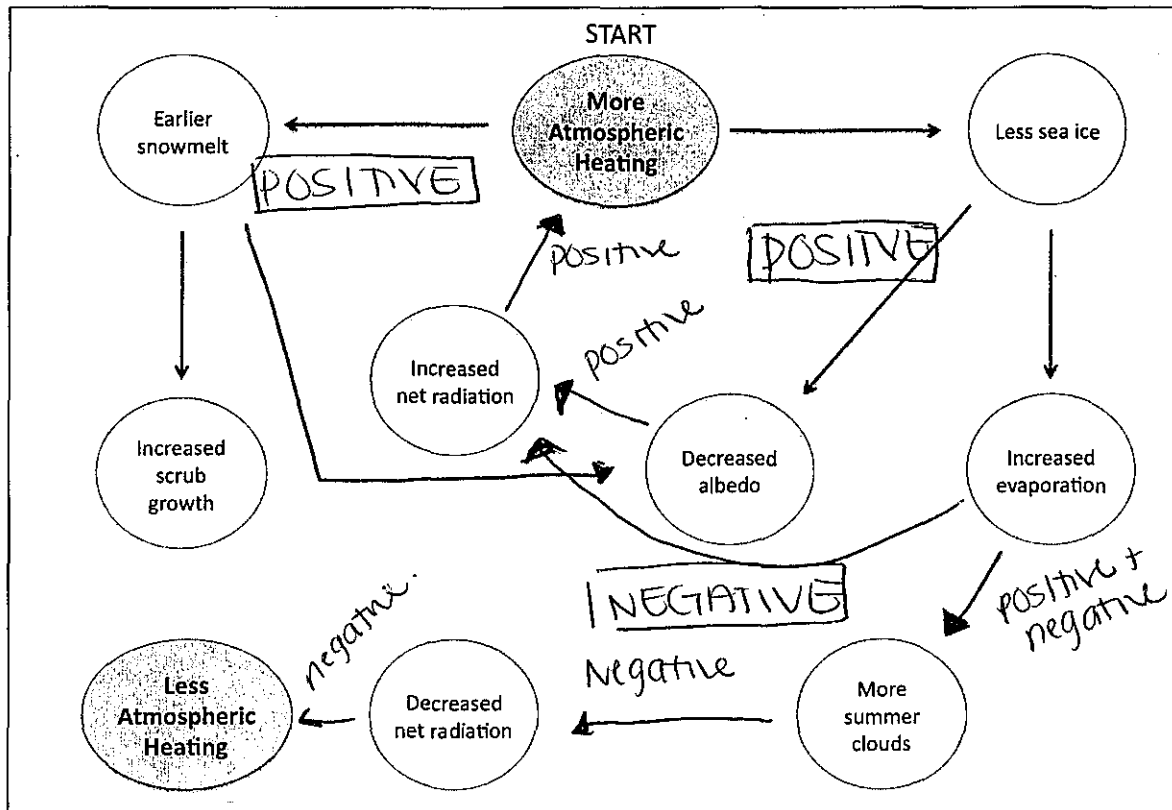
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive, because the glaciers aren't reflecting the light anymore, so the temperature continues to increase

ISP203A – Global Change  
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More heat causes less ice, cause more evaporation causes more clouds causes less net radiation causes less atmospheric heating, bringing temperature back to where it started!

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

when the atmosphere heats up, the sea ice melts, which is a decreased albedo, which increases net radiation which in the end cause the atmosphere to become hotter.

↳ in the beginning the atmosphere is heating up and in the end it is continuing to be heated up.



### Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

### Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

### Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO<sub>2</sub> from the atmosphere through respiration.

### Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.



AQ

ISP203A – Global Change  
Feedback Loops

R

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

**Causal Principles**

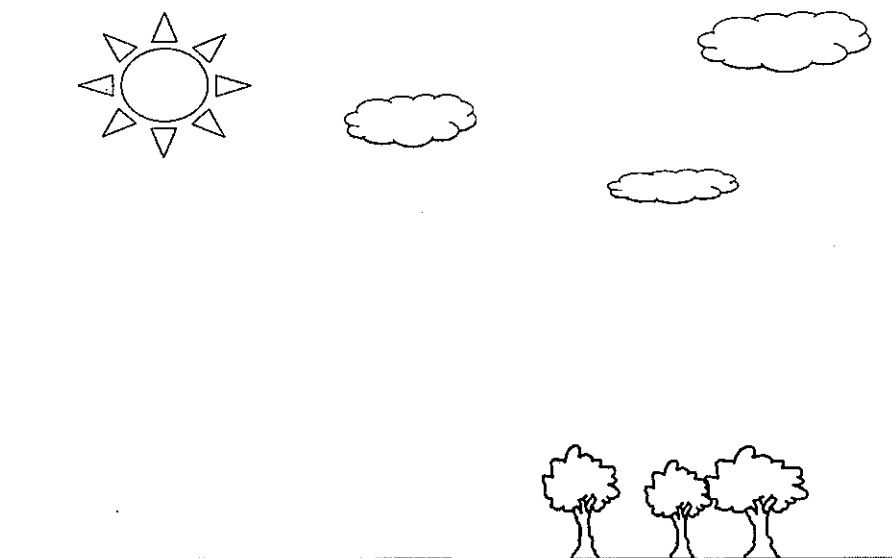
1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

~~ex~~ ↑ increases more evaporation  
Temp ↑ causes  
More evap which causes  
more clouds to form  
more incoming Sun light to be blocked which cause  
less production of infrared light

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



# greenhouses gases drive temp change

ISP203A – Global Change  
Feedback Loops

GROUP #: R

Student IDs of Members Present:

A40711430 A40608630

A40994271

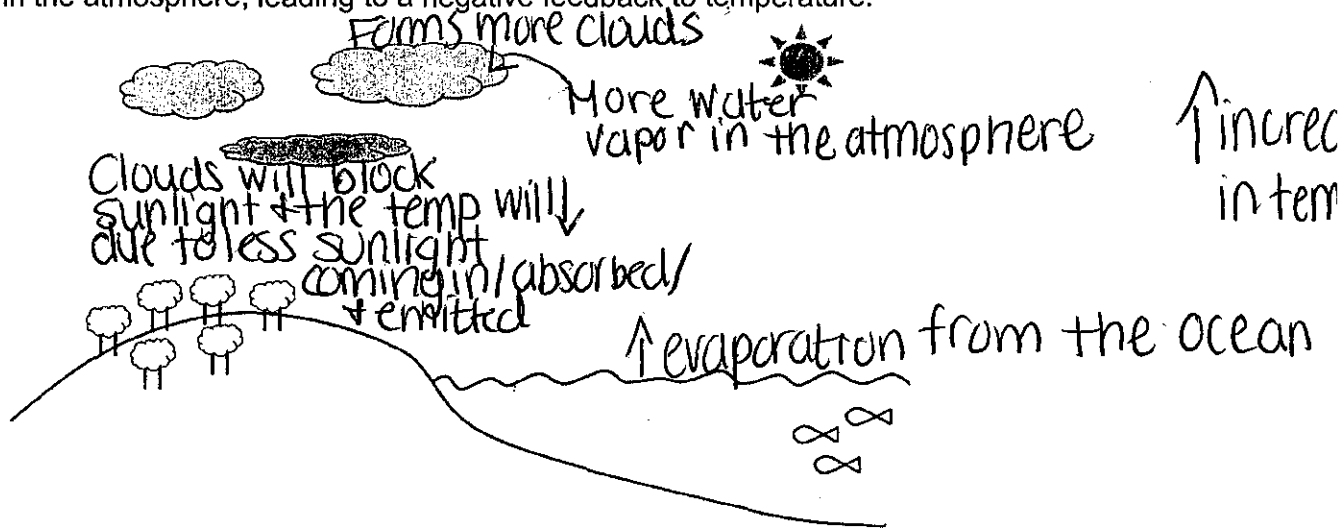
A39979926

## Part 2: Group Work

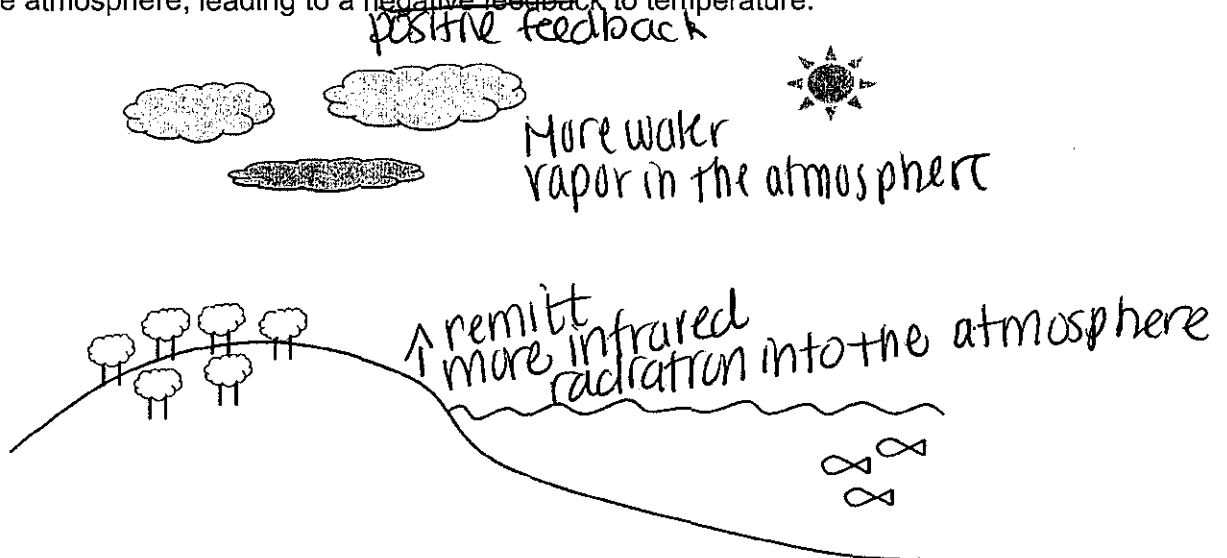
Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: *Changes the equilibrium when a equilibrium change in the sys causes further changes in the system such that some component in the sys overall*
2. Negative feedback: *change occurs, system reacts and moves + causes an opposite response, ↓ size of changes going on the system,*

3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.





?

R

### Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

Temperature increase causes more evaporation which causes more clouds to form which causes more incoming sunlight to be blocked which causes less production of infrared from absorbed sun. Temp goes up

- B. Which specific step makes this a negative feedback loop?

An event (temp increases) causes events (evap.) that causes less of the same temp (temp ↑ less).

- C. How might cloud cover produce a positive feedback?

An increase in water vapor will ~~ev~~ form liquid water. energy is released when you break bonds + releasing heat therefore heating up the atmosphere.

### Albedo:

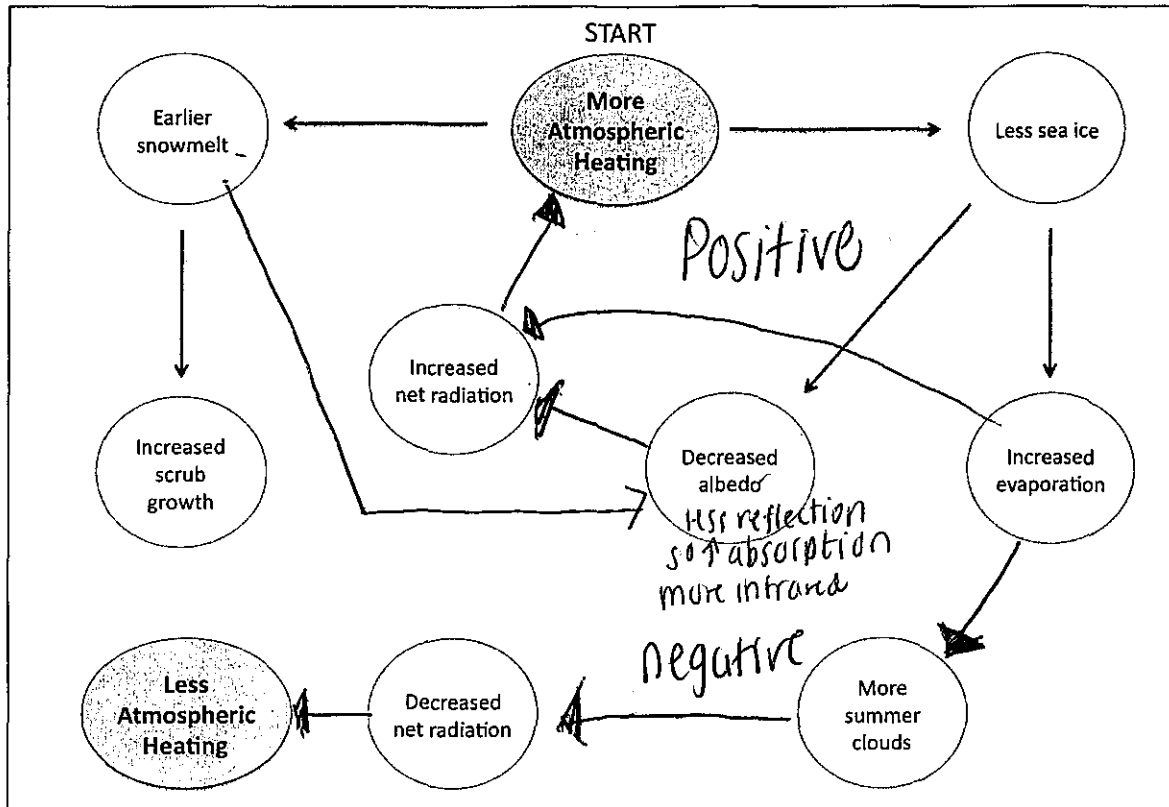
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

This would result in negative feedback loop because an event (increase in temp) causes events (glaciers and ice sheets) that causes less ice coverage on the Earth's surface.

ISP203A – Global Change  
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More atmospheric heating causes less sea ice which causes an increase in evaporation which causes more summer clouds, which causes a decrease in net radiation & then less atmospheric heating.

- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

More atmospheric heating causes less sea ice, which decreases the albedo, which increases net radiation, which increases more atmospheric heating.

ISP203A – Global Change  
Feedback Loops

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

**Aerosols**

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

**Rainforest**

Cutting down large portions of the forests on Earth kills living plants that remove CO<sub>2</sub> from the atmosphere through respiration.

**Permafrost**

Melting of permafrost will release methane gas, a greenhouse gas.



## ISP203A – Global Change Feedback Loops



### Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

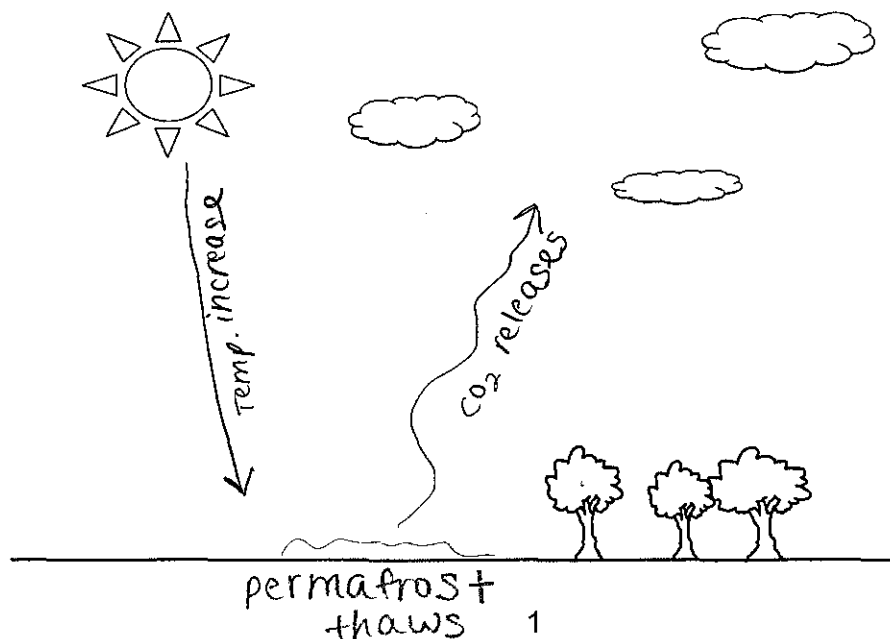
### Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

### PART 1: Background Notes

#### Part 1: Class Work

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



GROUP #:

Student IDs of Members Present:

A43292970

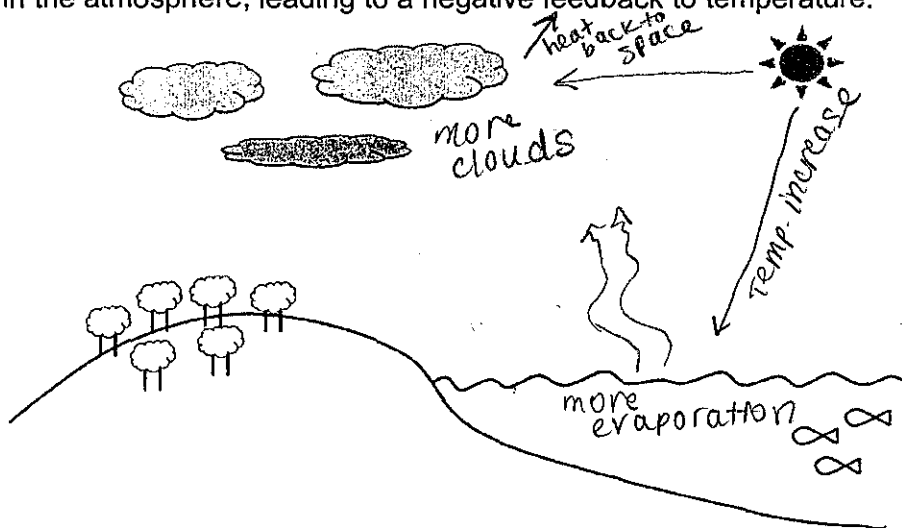
A43856550 A43294133

A39127449

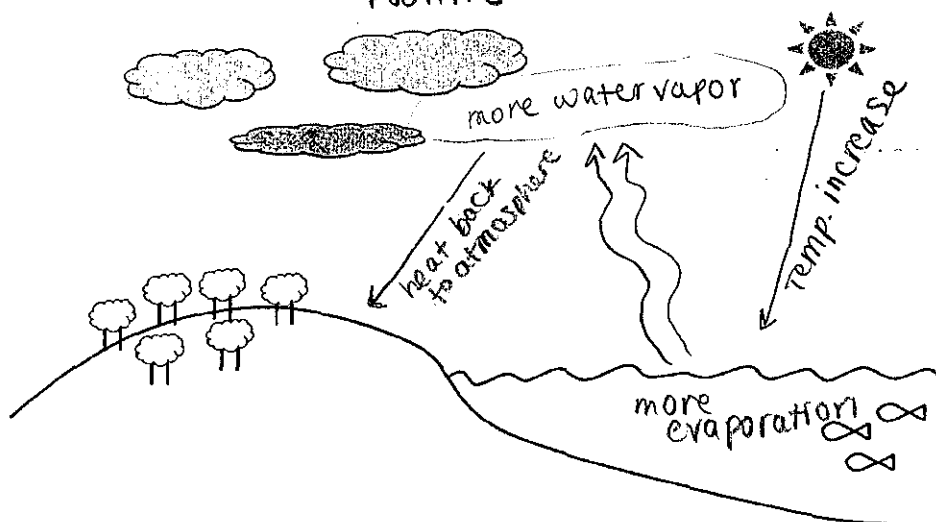
### Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: change in the system that causes more of the same change.
2. Negative feedback: change in the system that causes a change in the opposite direction as the original.
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ positive feedback to temperature.



S

### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

when temperature increases there are more clouds that form. The clouds block more sunlight from the atmosphere and reemit it in space.

B. Which specific step makes this a negative feedback loop?

same as above answer

C. How might cloud cover produce a positive feedback?

when clouds form, bonds are being formed. when bonds form, heat is released. thus temperature increases.

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

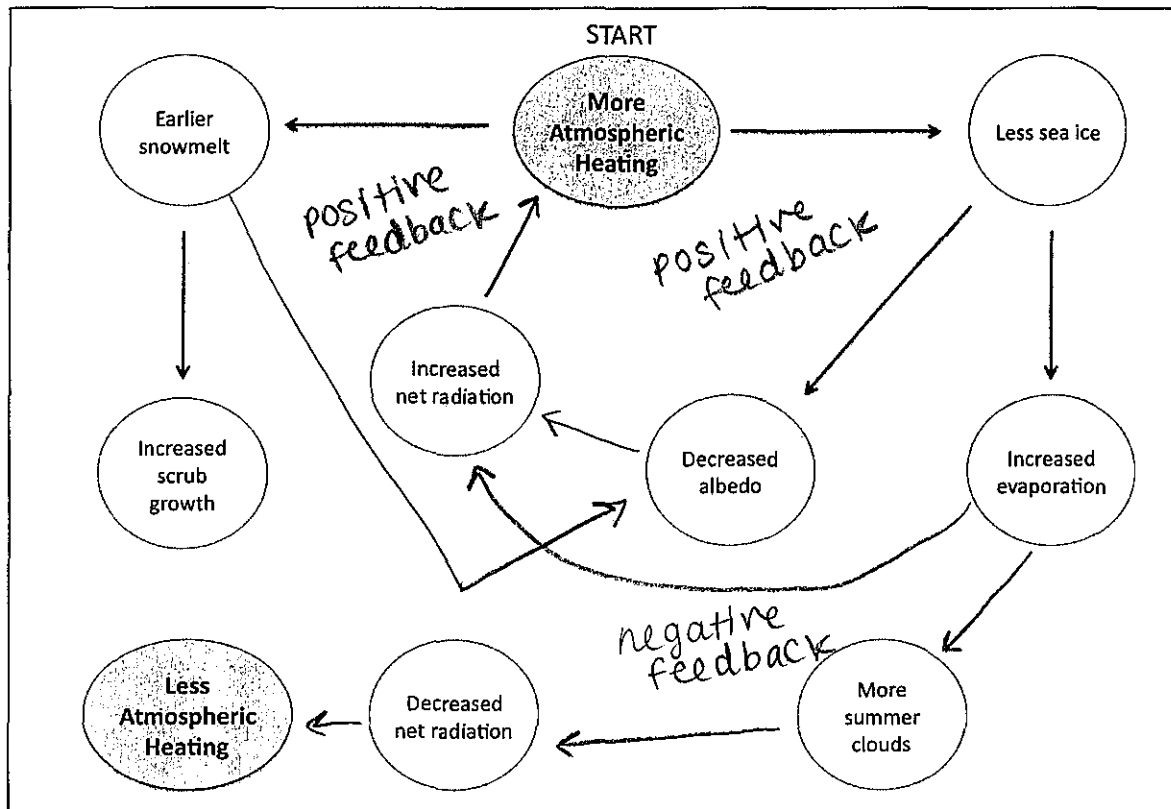
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

It would be a positive feedback loop.  
Temperature increases which causes ice to melt which causes less sunlight albedo which causes more absorption in the earth's surface which increases net radiation which increases the temperature.

ISP203A – Global Change  
Feedback Loops

5

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

more heating increases evaporation which creates more clouds which blocks sunlight from being absorbed and reflects heat back to space which means less atmospheric heating

- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

more atmospheric heating causes earlier snowmelt which decreases albedo (reflection) which increases absorption which increases



ISP203A – Global Change  
Feedback Loops

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

**Aerosols**

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

**Rainforest**

Cutting down large portions of the forests on Earth kills living plants that remove CO<sub>2</sub> from the atmosphere through respiration.

**Permafrost**

Melting of permafrost will release methane gas, a greenhouse gas.



ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

**Causal Principles**

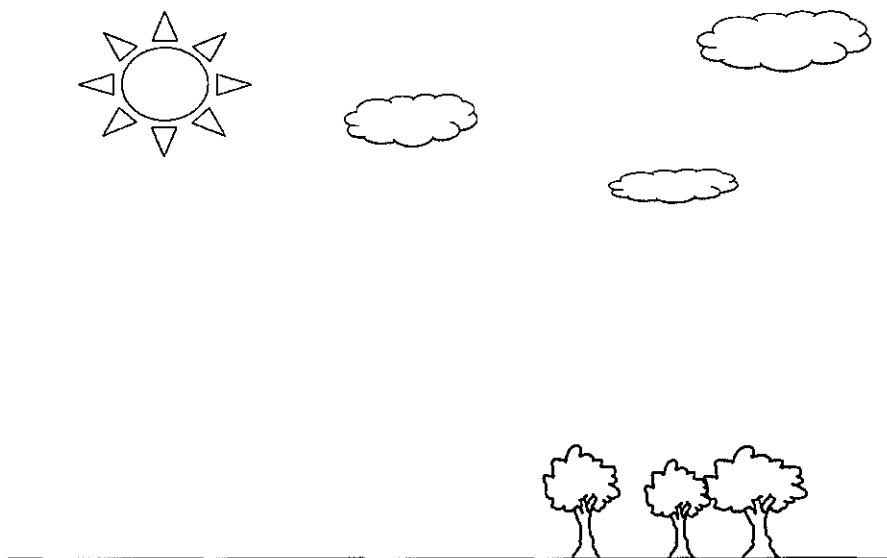
1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

more greenhouse gases temp ↑  
more water vapor condense you will form more clouds

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



GROUP #: T

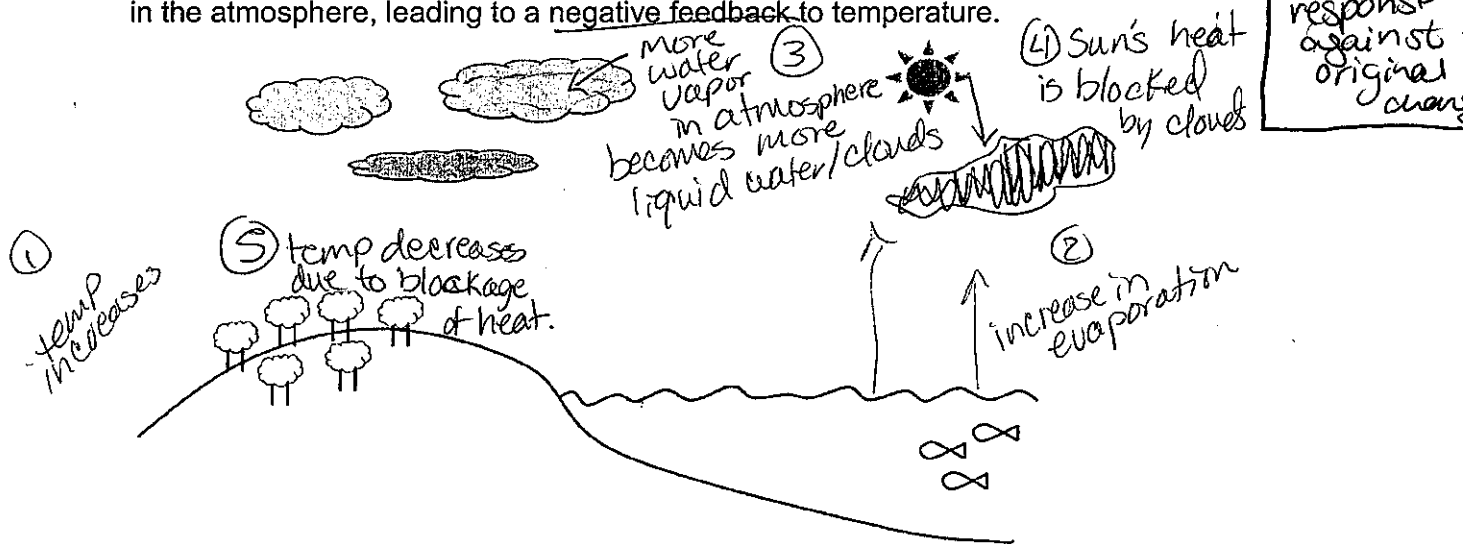
Student IDs of Members Present:

A39737915 A42185423  
A39743011  
A44013916

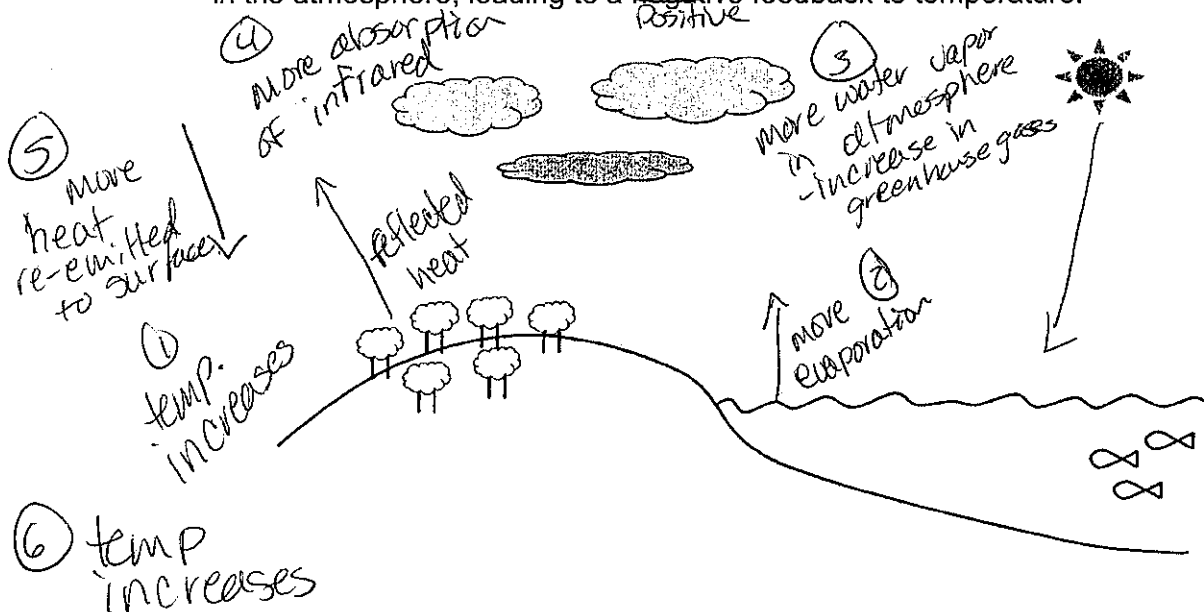
## Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: a change in a system causes further changes in the system such that some components in the system increase overall  $\rightarrow$  more of the same change
2. Negative feedback: you're at an equilibrium, change occurs system reacts  $\rightarrow$  moves back towards equilibrium  $\rightarrow$  causes opposite response against original change
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ positive feedback to temperature.



T

### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

cloud temp increases, causing increase in water vapor. greenhouse gases in the atmosphere causing more infrared heat from the sun. & increasing liquid water + clouds which blocks sun's heat from reaching surface, decreasing surface temp.

B. Which specific step makes this a negative feedback loop?

the blockage of the sun's heat caused by an increase in water vapor makes it negative

C. How might cloud cover produce a positive feedback?

It would be releasing heat that consequently leads to a rise in temp. in the atmosphere.

- increase in temp → increase in water vapor / greenhouse gas → increase of absorption of infrared → increasing surface temp.

### Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

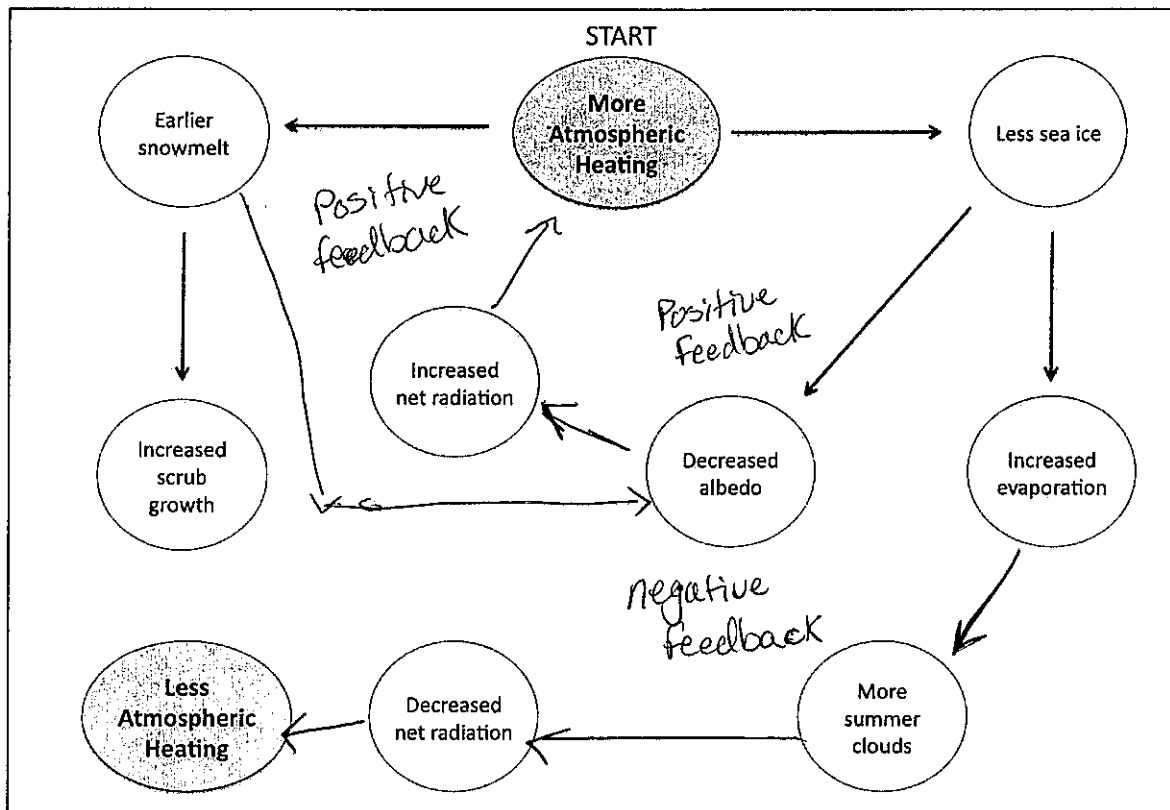
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive feedback loop because there is an increase which leads to another increase

## ISP203A – Global Change Feedback Loops

T

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

Cloud cover

-temp increases → more water vapor → more clouds  
 -system is not balanced - clouds block sunlight  
 → bring system back to equilibrium, increase in temperature is countered by a decrease in temperature

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Cloud cover

-temp increases - more water vapor, increase in greenhouse gas - cooling in atmosphere, ~~more~~ but then more absorption of infrared + re emitted to surface - causing increase in surface temp, bringing balance to system, moving towards equilibrium.



### Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

### Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

### Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO<sub>2</sub> from the atmosphere through respiration.

### Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

Cloud cover

Temp.  $\uparrow$  causes  
more evaporation which cause  
more clouds to form



ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

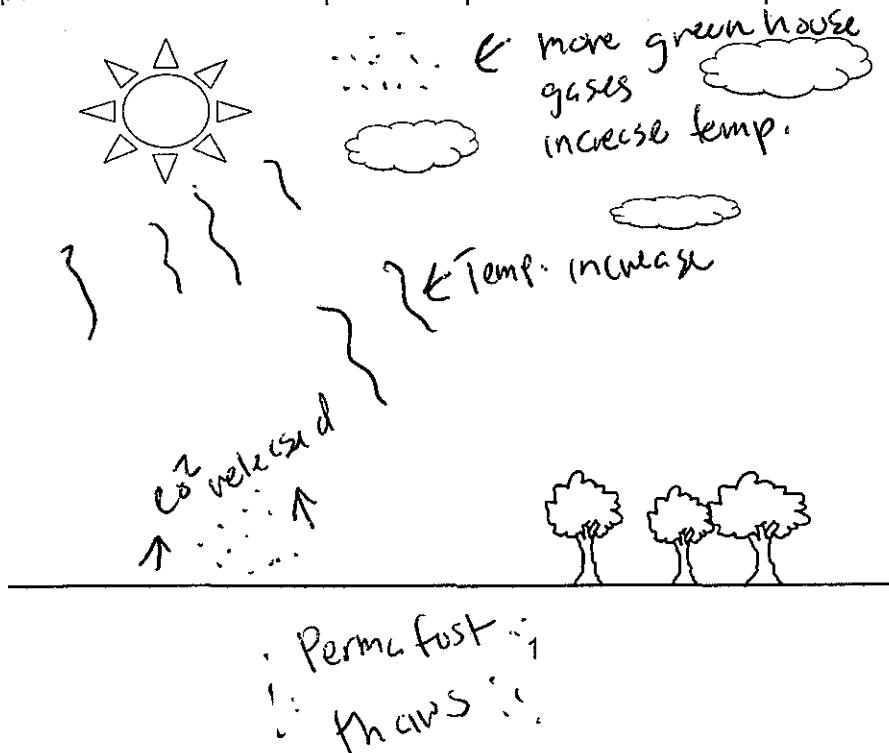
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.

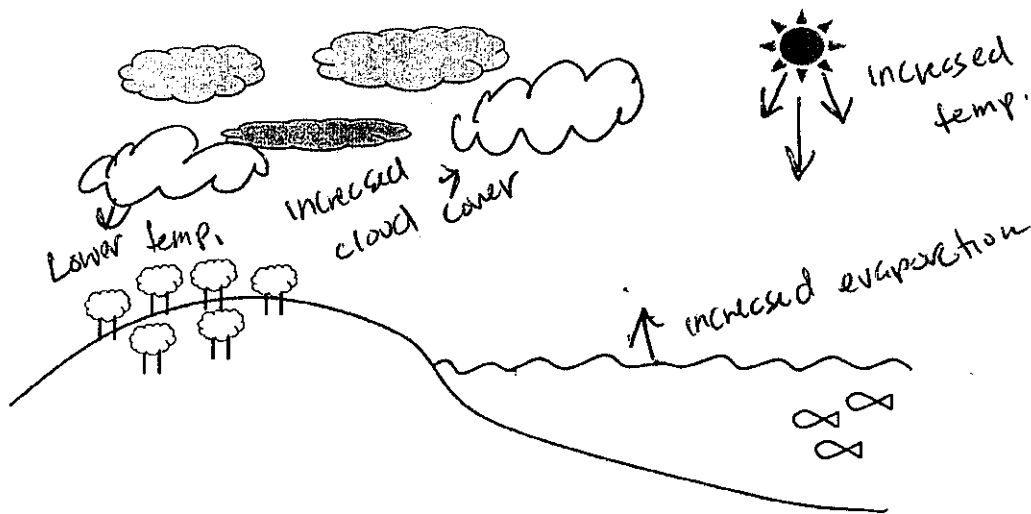


GROUP #: X  
Student IDs of Members Present:  
A93012134  
A31630943

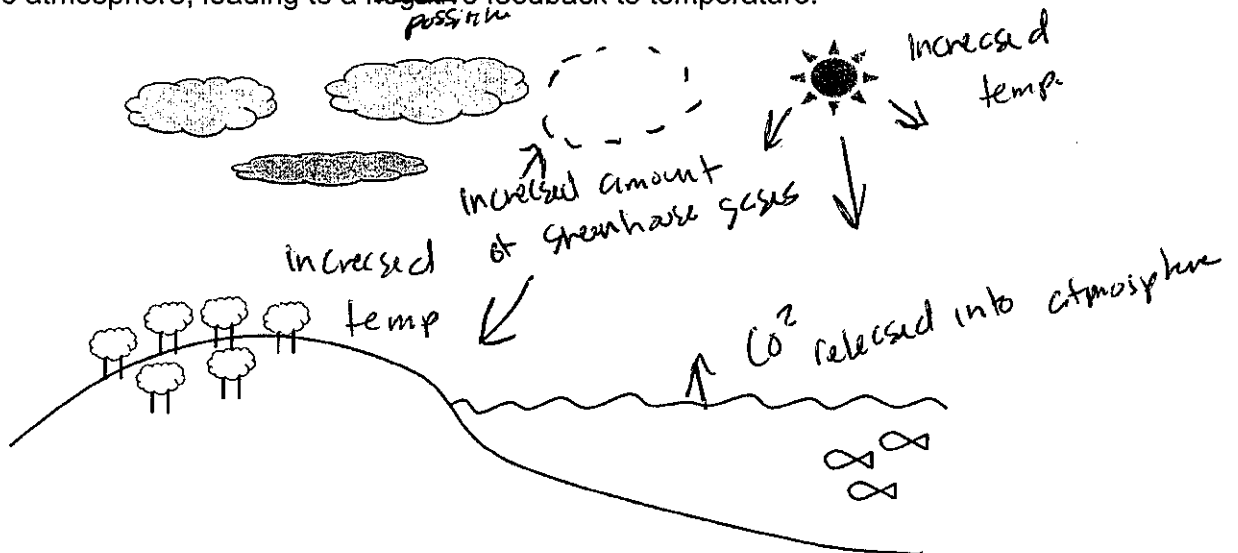
## Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: Change in the system causes further changes in the system such that some component in the system increases overall
2. Negative feedback: Change in system causes opposite response in the system such that the system is closer to equilibrium, ~~Decrease~~
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ <sup>positive</sup> feedback to temperature.



X

**Questions**

A. Why is cloud cover considered a negative feedback loop in a warming climate?

The clouds reflect more sunlight back into space and cool the surface temp. slightly.

B. Which specific step makes this a negative feedback loop?

It is negative because the increased temperature leads to lower temperature.

C. How might cloud cover produce a positive feedback?

When clouds are created bonds are created releasing heat energy.

**Albedo:**

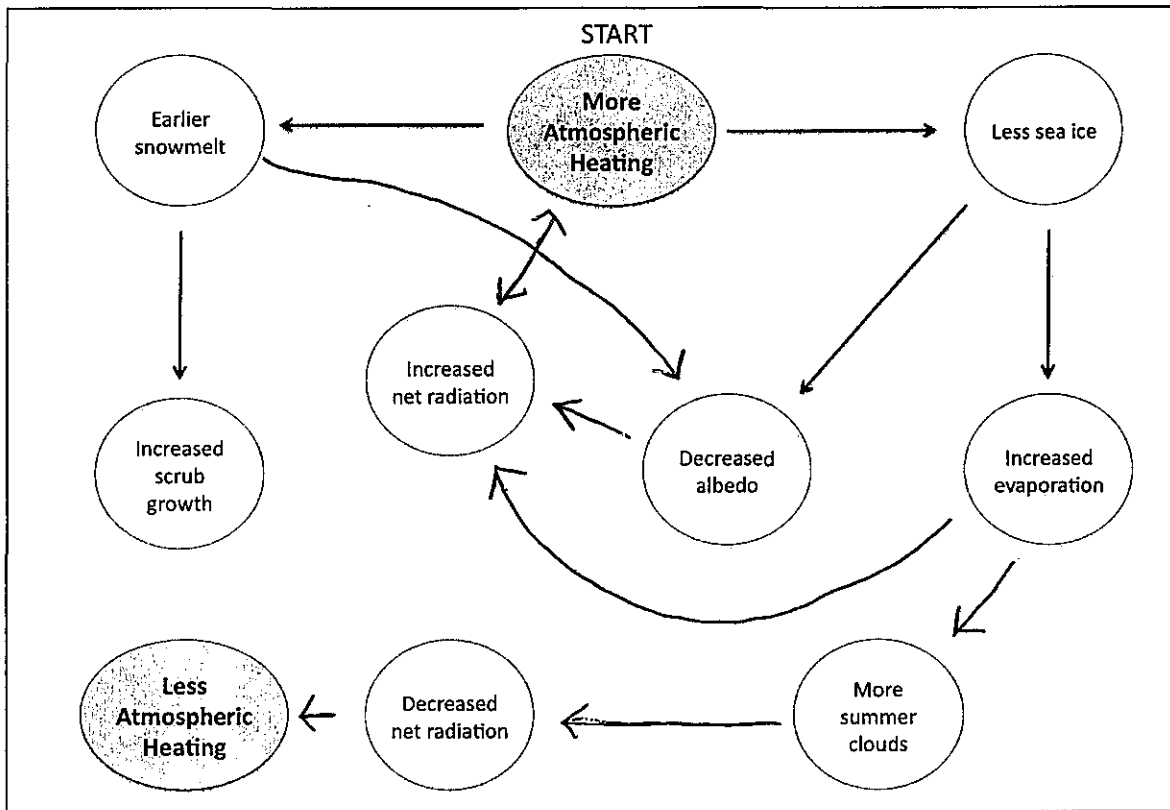
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Possible feedback b/c if there is ~~glaciers~~ reflection

## ISP203A – Global Change Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



positive

- E. Pick a ~~negative~~ feedback loop and explain how it brings the system closer to equilibrium.

The increased atmospheric heating leads to less sea ice, less ice decreases the albedo which increases net radiation. This leads more atmosphere heating.

negative

- F. Pick a ~~positive~~ feedback loop and explain how it moves the system away from equilibrium.

As the atmosphere heats it melts the sea ice which leads to increased evaporation leading to more clouds. This leads to less atmospheric heating.

ISP203A – Global Change  
Feedback Loops

**Objectives**

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

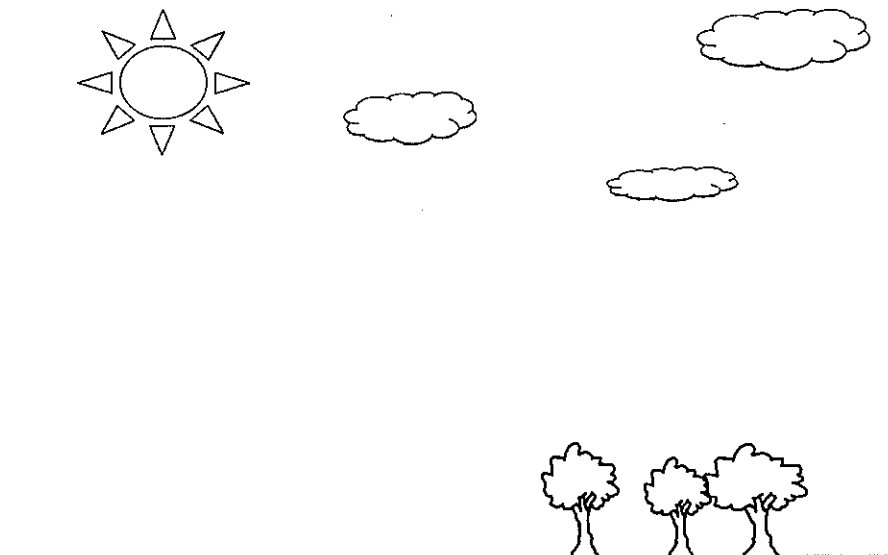
**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 1: Class Work**

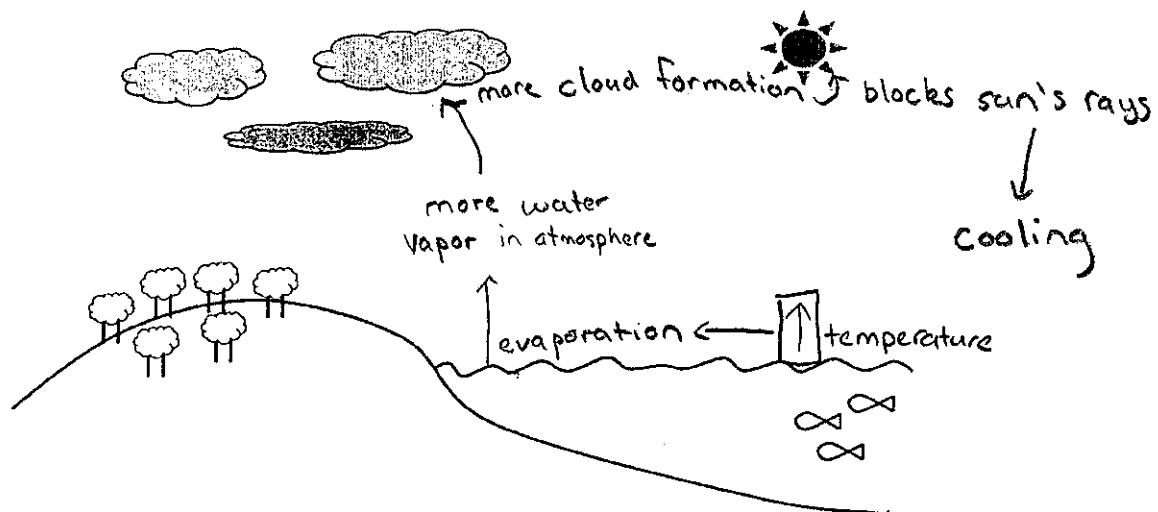
A. On the diagram, label the steps that illustrate the positive feedback loop for temperature between atmospheric temperature increase and permafrost.



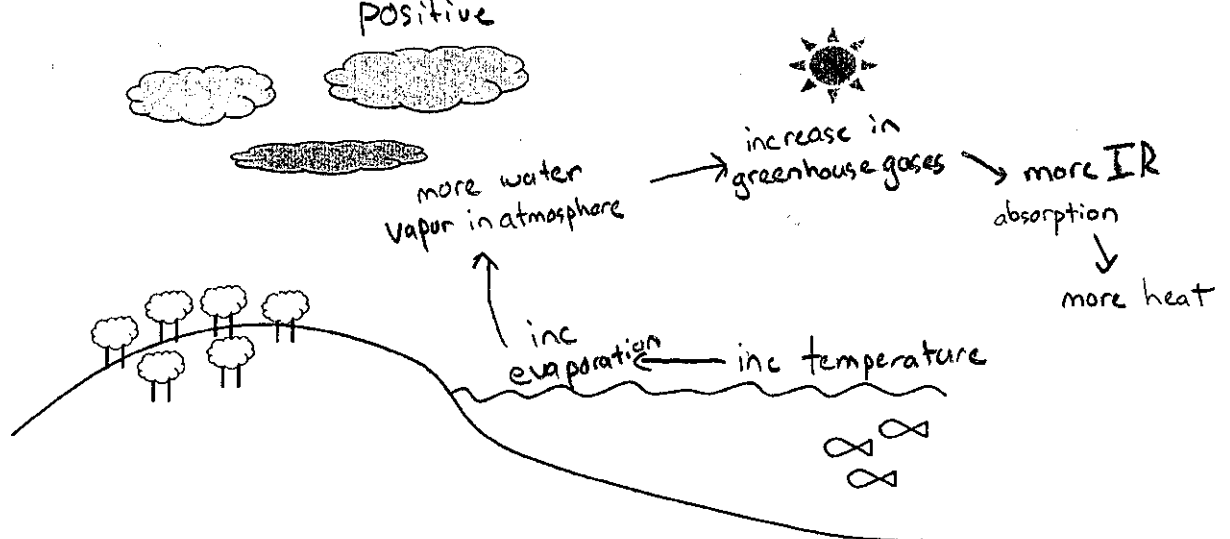
## Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: A change in the system causing further changes in the system such that some component in the system increases overall.
2. Negative feedback: A change in a system causing an opposite response in the system to return to equilibrium.
3. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a negative feedback to temperature.



4. On the diagram below, show how an increase in temperature can affect water vapor in the atmosphere, leading to a ~~negative~~ **positive** feedback to temperature.



V  
Y

### Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Cloud cover blocks the sun's rays from hitting the Earth's surface, to be converted to IR.

B. Which specific step makes this a negative feedback loop?

The reduction of IR rays from the cloud reflecting.

C. How might cloud cover produce a positive feedback?

Producing a cloud forms bonds, releasing energy.

### Albedo:

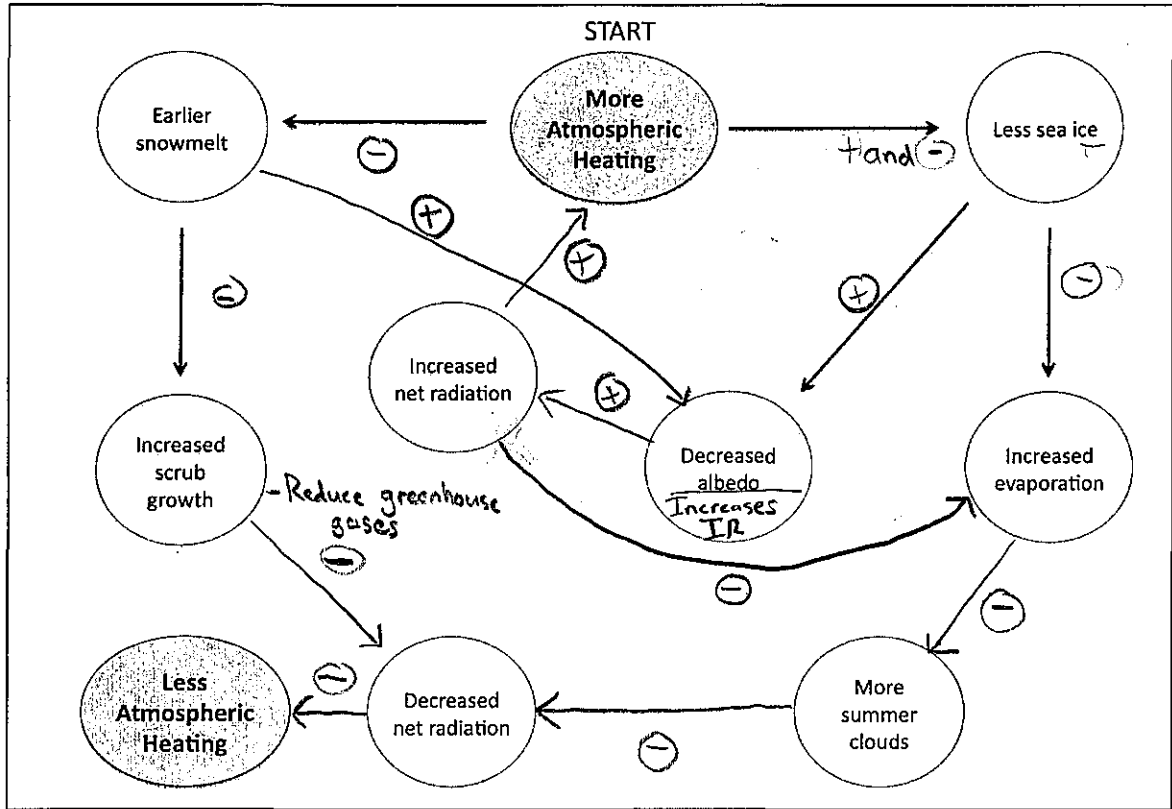
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive. Global warming would melt glaciers & ice sheets. CAUSING  
More surface area to absorb the sun's radiation CAUSING  
More thermal energy being converted CAUSING  
more warming.

# ISP203A – Global Change Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

*paced out*  
 inc heat → less sea ice → inc evap → more clouds → dec radiation  
 an increase in heat melts surface ice. This ice used to directly reflect sunlight, not converting it. The melted surface converts the sunlight to IR, getting trapped by greenhouse gases, heating the Earth.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

inc heat → less sea ice → dec albedo → inc radiation → inc heat



## ISP203A – Global Change Feedback Loops

### Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

### Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

### Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO<sub>2</sub> from the atmosphere through respiration.

### Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.